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On Errors committed by Writers on Mechanical Engineering. By WILLIAM TRURAN, Esq.

The science of engineering has advanced with immense strides during the last few years, until it has become the great agent of civilization and commerce. Examples of successful engineering structures, which, but a few years since, would have been considered impossible, are now of almost daily occurrence. In road-making, bridge-building, steam-navigation, and manufactures generally, we see the rapid progress of engineering science. Many of these great works have been designed and erected by self-educated men; but in the present day, the man who has received a combined theoretical and practical education, can undertake a work with an assurance of a successful completion, which the former cannot. The publication of numerous valuable works on engineering and mechanics, has placed the means of acquiring the theoretical principles of these sciences within the reach of the practical and the self-educated man. It is to be regretted, however, that in several instances, the theories laid down for guidance, are manifestly incorrect, and have caused much embarrassment to the student, and great loss of time and capital to the practical man.

In this and future papers, we purpose drawing the attention of theoretical and practical engineers to some of the most obvious and common errors which are to be met with in publications intended for their especial use. We will begin with one which is found in nearly every text-book

on mechanics, and which seems to have originally emanated from a celebrated French philosopher:

"Two men working at a windlass with handles at right angles, can raise 70 pounds more easily than one can raise 30 pounds." "*Desaguliers.*"

On an attentive consideration, the incorrectness of this statement will be evident to the student. If one man is capable of raising 30 pounds only, two men will raise twice this weight, or 60 pounds, and not 70 pounds, as Desaguliers asserts. If we deny the correctness of this dictum, we must be prepared to show the source from whence any additional power over the 60 pounds is obtained. This we are unable to do satisfactorily. Were we to admit that a gain of power resulted when two men were at work, we must also allow, that with an increased number of men, the gain of power will be correspondingly great.

It is very probable that the inference intended to be drawn from the statement, was the benefit which would accrue by having the two handles of a windlass at right angles to each other, instead of being diametrically opposite, as we observe them to be in practice. But to assert that by such arrangement the men can easily raise one-sixth more than if the handles were otherwise set, is manifestly incorrect. It requires no mathematical investigation to ascertain that if a weight of 30 pounds is to be raised, the requisite power must be exerted, and if 35 pounds is to be raised, a proportionately greater power must be exerted, whatever apparatus be employed for transmitting that power.

The mistaken impression, that a gain of power follows when the handles of a windlass are set at right angles, is unfortunately current among a large number of practical engineers, and prevails, also, with the majority of educated scientific men in Europe. That no gain or advantage can really accrue in practice by such arrangement, a brief consideration of the conditions under which a man labors at a windlass will prove.

Let the annexed diagram represent the circle described by the handle of a windlass during one revolution; the motion being in the direction of the letters. For convenienc of reference, the circumference of the circle has been divided into four equal parts opposite the letters A, B, C, and D. Assuming that one man is at the handle of the windlass, which stands at the usual height, we shall perceive by reference to the diagram, that in moving from A to B, the man applies his power by lifting; one of the most favorable positions in which a man can exert his strength. Generally, a man can lift nearly one and a half times his own weight. From B to C, the power is applied by pushing—the resistance being nearly on a level with his chest. The force which a man can exert at this height is small, certainly, not exceeding the half of the weight of the operative. From C to D, his power is exerted in pressing down the handle, and the force which can be applied, during this portion of the revolution, is equal to, but cannot exceed, the weight of the man. From D to A, his power is applied by pulling, and in this direction when the line of resistance is low, as in the case of windlasses and boat rowing, he can exert

great power—not less than one and a half times his own weight. With one man only at the windlass, we observe that the power which he is capable of momentarily exerting, varies with the position of the handle, being at one period nearly three times the amount exerted at the least effective point.

With two men working with handles set at right angles, the irregularity of the power which the men are capable of exerting, is nearly as great as with one man. For if we suppose that when one handle is at A, the other is at D, the two positions in which the greatest force can be exerted; and that in revolving they will afterwards be at B and C—the two points where the least power can be exerted by the men,—it is difficult to see how the arrangement of the handles thus can be conducive to regularity of motion, much less to the absolute gain of power, as many persons maintain.

The believers in this gain of power have evidently overlooked the important fact, that during the revolution of the winch handle, the varying positions which a man takes, render him less or more powerful throughout. The power is not equally great at all points during the revolution, but at no time is it entirely suspended. There are no dead centres like those in a crank, worked by a connecting rod. The operative exerts at the least effective period, full one-third of the power which he is capable of exerting under any circumstances, and considerably more than he is capable of maintaining for any length of time.

Were there two points in the revolution of the handle, at which a cessation of the propelling power took place equidistant from each other, the arrangement of the handles at right angles to each other would tend to equalize the power, but a consideration of the diagram demonstrates that a considerable diminution in the power takes place at one period only. At the point opposite to this diminution of power, the man is capable of exerting his greatest effect; therefore, the greatest uniformity in the motion will be obtained when the handles are so arranged that, while one is passing over the space during which the least effective power can be exerted by the operative, the other shall move in the direction in which he can exert the greatest power. This is accomplished by placing the handles diametrically opposite to each other.

In practice, we invariably see the handles placed on opposite centres. On examining cranes, crab-winches, windlasses, or any other machines on the same principle, we do not find the handles at an angle to each other, but the reverse. When placed diametrically opposite, the operative imagines, and not without reason, as we have endeavored to show, that the work is easier than when placed at right angles or in the same plane; and there is the further advantage, that being on opposite centres the weight of one handle balances the weight of the other.

That this common mistake regarding the extra power got by setting the handles at right angles, is not confined to a few persons, but is believed in by some of the ablest writers, we will endeavor to show, by making an extract from a letter, written by Mr. J. C. Robertson, C. E., and for nearly thirty years editor of the *London Mechanics' Magazine*, to a private correspondent, dated March, 1849:

"The force of two men rightly applied to a crank, is more than twice one in the proportion of 70 to 60."

When the editor of the *London Mechanics' Magazine*, a civil engineer, and one of the ablest writers on mechanics and mathematics of the day, believes in such gain of power, we may well excuse a similar mistake in less able men. But with all due deference to Mr. Robertson's abilities as a writer and mathematician, we must doubt his obtaining from two men more than twice the power of one.

In Europe this imaginary gain of power by the employment of cranks at right angles, has, in numerous instances of mechanical engineering, been productive of much complexity of construction and great waste of capital. Practical engineers have reasoned that if there is a gain of power by disposing the handles of a windlass at right angles, a similar disposition of the cranks of machines driven by steam, water, or other inanimate power, would be attended with like advantages, and have constructed their engines and machines with such cranks, in the full belief that a positive gain of power is thereby obtained. On no other supposition can we account for the immense number of steam engines in Europe having two cylinders with their cranks at right angles. Where the power required to be given out by such engines is so great, that manufacturing engineers have not machines of the requisite calibre for their construction, the employment of two cylinders may be advisable. In ocean going steamers, also, the employment of two engines may be attended with some advantage in the facility of repairing, and the ability to continue the voyage if one engine is disabled. And in locomotive engines, the use of two cylinders is probably attended with advantage.

But the universal employment of two engines in river going steamers, and the very general use in all land engines, for mining, and driving mills, factories, blowing machines, &c., of two cylinders, can be attended with no advantage, commensurate with the greater first cost of such engines over single cylinder engines of equal power, and the greater cost of maintaining them in an efficient working state. The first cost of two engines, as compared with a single engine of equal power, will be as 4 to 3. The cost of repairs and renewals will be in the proportion of 3 to 2, and the loss of power from friction and leakage will be in a similar ratio. Hence a single engine, of given power, will cost one-fourth less at first, and may be worked with one-third less expense in repairs and leakage, than a pair of engines, collectively, of the same power.

For the Journal of the Franklin Institute.

On the Durability of Railroad Iron. By WILLIAM TRURAN, Esq.

The duration of the iron rails of our great railroads is a subject of vast importance to all interested in the maintenance and extension of railway communication. In all estimates for new roads for thinly settled districts, the cost of the iron rails figures as the most prominent item; and even in the thickly settled States of Europe, where the metal is obtained at a comparatively cheap rate, the cost of the rails forms no inconsiderable portion of the whole expense of construction. On the first introduction of railroads, it was confidently asserted by their promoters, that the iron

rails would last for an indefinite period. A few months working, however, demonstrated that although manufactured from the best metal, iron railway bars were subject to lamination and disintegration from the repeated rolling of heavy loads. Their duration, in numerous cases, did not exceed two or three years, and in no instance of a railroad having a heavy traffic, have the rails remained sound and in working condition for more than 14 years. On some of the earliest constructed lines in England, the rails have been changed twice and even three times within twenty years. Opportunities have, therefore, presented themselves to the engineers of such lines, of ascertaining the actual traffic which iron rails are capable of withstanding under different circumstances. But if note has been taken of the facts relating to rails which have been taken up, it is to be sincerely regretted, that they have not been recorded in one of the numerous scientific publications of Europe or this Country. Their publication would be of the greatest benefit to railroad companies, and, eventually, would be of esential service to engineers and scientific men generally.

The traffic which rails of ordinary quality are capable of bearing, will depend on circumstances; but where the conditions are of a favorable nature, and the bars themselves perfectly sound, it will not fall far short of twenty millions of tons. But, although rails will stand the rolling of this traffic, those which are daily observed in a dilapidated state on numerous railways, have not, in the majority of cases, carried the one-fourth of this traffic; and immense quantities of rails have doubtlessly been renewed before they have borne the one-tenth of this weight. Well recorded observations are wanted on this head, and pending the publication of more extended observations, the writer would direct attention to the following observed cases of rails, which have stood the carriage of several millions of tons under very disadvantageous circumstances.

It may be necessary to state, that the rails used in every case, but the last, were of the usual quality, (those in case 2 are a portion of the bars manufactured for the Moscow and St. Petersburg railway.) They were manufactured in manner commonly pursued at Welch rolling mills, and were, in point of quality and appearance, equal to any manufactured, or in use in Europe. The rails in the Hirwain road were rolled from inferior metal, and were not, in other respects, well manufactured.

It may be necessary also, to mention in this place, that the gross weight of the trains is given in every instance. This, it is believed, is preferable to giving the weight of the freight and omitting the weight of the engine and cars, which may be unnecessarily heavy or light for the loads which they convey.

Case 1. Railroad for the conveyance of minerals, near Merthyr Tydfil, Wales, length, 2 miles; gauge, 4 feet 8·5 inches. This line is a gradient of 2 inches rise in the chain through its whole length, and contains curves so low as 3 chains radius. The wagons employed weigh 3 tons 12 cwts. when empty, and 7 tons 1 cwt. when loaded. They are mounted on 4 cast iron wheels, 30 inches in diameter, keyed fast on the axles, and have outside bearing brasses, but neither buffer, draw, nor bearing springs. The motive power consists of locomotive engines weighing

from 14 to 16 tons each, exclusive of tender. The rate of hauling, ranges from 10 to 16 miles an hour.

This line was originally laid in a very temporary manner, with bridge rails 2·5 inches high, 2 inches wide at the top or bearing part, and 6 inches at the foot; and weighing 56 lbs. per yard lineal. They were fastened by spikes through the flanches to cross sleepers, 6 inches by 4 inches, by 6 feet long, at intervals of 4 feet. The ballasting consisted of the clay and peaty soil excavated from the side drains, and distributed in a layer one foot thick under the sleepers.

After two years' wear, with the engines and wagons described above, the original rails were laminated to an extent that rendered their renewal a matter of necessity. The gross traffic that passed over them during that period, amounted to 1,822,800 tons. Had these rails been supported by larger sleepers at shorter intervals, and these sleepers packed up by proper ballasting, they would have stood the wear and tear of from twice or three times the above quantity of traffic.

Case 2. The railroad previously described, was relaid with T rails 3·75 inches high, 2·5 inches wide at the head, and 3·5 inches broad at the foot; and they weighed 63 pounds per lineal yard. The small sleepers were replaced by others, averaging 9 inches wide, by 9 feet long, at the reduced distance of 3 feet apart from centre to centre. The rails were also supported on shallow cast iron chairs, which were spiked to the sleepers, and the clay ballasting was strengthened by the addition of a thick layer of broken stones. The new rails with the altered mode of laying, have now been in use ten years, during which period the gross traffic over them has been 9,710,000 tons.

The height of these rails when new, was 3·75 inches, as previously stated, but by wear and abrasion from the rolling of the above weight, their height has been reduced to 3·63 inches. Taken collectively, these rails have endured very well, and with the exception of a very few crushed and bruised bars, which will require immediate renewal, they will, probably, continue fit for the traffic for at least three years again. Hence their duration may be estimated as equal to the movement of 12,600,000 tons.

To show the ill effects which must result from inattention to the state of the sleepers, at different places on the line, a sleeper end was permitted to remain without proper support. After the lapse of a few days, the rails immediately over the slackened sleepers, were found crushed and flattened for a length of 6 or 7 inches, so as to reduce the depth of the bar from 3·63 to 3·2 inches. Similar results followed, when the distance between any two sleepers was increased to more than 4·5 feet; thus showing the necessity of having, under the rails, a firm and rigid support at very short intervals, to prevent as far as possible all injurious deflexion.

In those rails which have broken down, either from lamination, or during the foregoing experiments, the impropriety of using any other than puddled iron in the top surface of the rail was fully displayed. These rail bars were manufactured from piles of the ordinary quality and description, with a top plate of the so-called "best iron," one inch in thickness. This plate in the course of rolling was reduced in thickness,

to ·16 of an inch in the finished bar. Now, all the lamination which has yet been discovered, has occurred with this superficial coating of "best iron," which has often pealed off, in long narrow strips or splinters, of several feet in length.

Case 3. Mineral railroad, consisting of a steep incline plane of the 4 feet 8·5 inches gauge, with a double track of rails, each 480 yards long, and falling 6·7 feet per chain. The direction of the traffic being downwards, this portion is worked by the gravity of the descending full wagons, which are made to draw up the empties, by means of ropes, working over rope rolls and friction drums, revolving on gudgeons at the incline top. The rails were of the bridge pattern, 2·5 inches high, 2 inches wide at top, 6 inches broad at the foot, and weighed 56 pounds per yard. They were supported on flat cast metal chairs, which were spiked to transverse sleepers of 8 inches wide, by 8 feet long, placed 3 feet apart. Under the sleepers, there was a thin stratum of clayey soil as ballast.

The wagons described in case 1, roll over this section, also, at velocities averaging 12 miles per hour. The rails on this section were in use for eleven years, during which time the traffic over them amounted to 8,087,000 tons, equal to 4,043,500 tons over each track. The injury which results to the rails from the absence of adequate support under the sleepers was manifest in this case, and, undoubtedly, was the means of shortening their duration fully one-half.

While forming another mineral railroad, crossing under this section, it became necessary to evacuate an opening, 10 yards wide, over which the rails were carried by four pieces of pine timber; one being placed under the centre of each rail bar. The deflexion of the beams by the passing of the loaded wagons, was from 2·5 to 3 inches, and from this cause alone, the whole of the rails on these pine stringers were battered and laminated so as to require renewal in the short space of two months, and after they had borne a traffic of no more than 61,300 tons.

Case 4. Mineral railroad, on a dead level throughout, consisting of a single track of bridge rails, the same as those described in case 1, but spiked directly to sleepers, averaging 6 inches wide, by 6·5 feet long, placed 3 feet apart on broken limestone, as ballasting. The wagons previously described, work over this section also, but the motive power being horses, the rate of traveling rarely exceeds three miles an hour. The rails on this section have now been in use eleven years, have borne a traffic of nearly 4,900,000 tons, and with the renewal of the wood-work of the line, will probably last for a similar period, and for the passage of an equal quantity of traffic. Their duration may, therefore, be assumed to be equal to the transport of 9,800,000 tons.

From the foregoing examples it will be seen, that while bridge rails, weighing 56 pounds per yard, were destroyed with the passage of 1,822,800 tons, hauled at a velocity of 12 to 16 miles an hour, by locomotive engines, weighing from 14 to 16 tons each; with the same wagons, but at the reduced speed of 12 miles an hour, they have stood under the passage of 4,043,500 tons; and with the same wagons, but at the still further reduced speed of 3 miles an hour, they have stood the wear and tear from the passage of 4,900,00 tons, without material injury.

Case 5. Railroad for the conveyance of coal, consisting of an inclined

plane, falling 7 inches per yard, forming a double track of rails of the 4 feet 8·5 inches gauge, 400 yards long, and worked by stationary steam power at top, through the medium of ropes and drums. The rails are of the inverted U pattern or Evans' patent, weight 90 lbs. per yard, were 3·4 inches high, 2·74 inches wide at the head, 4 inches wide at the foot, rolled in lengths of 15 feet, and supported at intervals of 3·5 feet, by cast iron chairs resting on massive blocks of limestone.

Each track of rails is traversed by a single wagon, mounted on four cast iron wheels, 2 feet diameter, keyed on wrought iron axles, and revolving in brass fitted plummer blocks bolted to the frame work of the wagon. The weight of the wagon when empty is 7 tons 2 cwts., when full, 13 tons 16 cwts., and it is drawn at an average speed of 8 miles an hour.

These rails have now been in use seventeen years, and the gross traffic which has passed up and down the plane, amounts to 11,016,000 tons, or 5,508,000 tons over each track. The result of this traffic has been to reduce the height of the rails from wear and abrasion, from 3·4 to 3·26 inches. In other respects they are in good condition, and will probably sustain a further traffic of 3,500,000 tons, making their duration equal to 8,000,000 tons.

Case 6. Railroad for the conveyance of limestone, a single track 2½ miles long, worked by horse power. The rails were of the fish-bellied section, 5 inches high, 2 inches wide at the head, and ·75 inches thickness of centre web, weighed 55 pounds per yard, and were laid in cast iron chairs, resting at intervals of 3·5 feet on limestone blocks of from 2½ to 3 cwts. each.

The wagons, which were made wholly of wrought or cast iron, weighed, when light, 1 ton 19 cwts., and when loaded, 8 tons 10 cwts. each. The wheels were 2 feet 6 inches in diameter, and turned loosely on the axles, which were bolted to the under side of the carriage.

These rails stood for nine years with an average annual traffic of 180,960 tons, or a gross total of 1,628,640 tons, when they were replaced by stronger bars.

Case 7. Railroad consisting of an inclined plane, with a double track of rails raising 6·7 feet per chain forward. Rails of the bridge pattern, weighing 56 pounds per yard, 2·375 inches high, 2·125 inches wide at head, and 5·625 inches at the foot; spiked directly to cross sleepers 9 inches wide, by 9 feet long, at distances of 3 feet 3 inches apart. The sleepers repose on a thick deposit of broken scoria, from the blast furnaces in the neighborhood, which is found to be an excellent material for ballasting the permanent way of railroads.

The wagons running on this road are of wrought iron, mounted on 4 cast iron wheels, 30 inches in diameter, turning loosely on their axles, and are without springs of any kind. They weigh when light, 1 ton 8 cwts., and when loaded, 4 tons 16 cwts.; and are drawn by stationary steam power acting through drums and chains, at an average speed of 6 miles an hour.

These rails have been in use thirteen years, and appear but very little the worse for the traffic which has passed over them. This has amounted to a gross weight of 7,840,000 tons, or 3,920,000 tons over each track.

Their duration may be fairly estimated at twice this weight, or 7,840,000 tons over each track of rails.

Case 8. Railroads for the conveyance of goods, metals, and minerals, consisting of a single track of rails of the bridge pattern, weighing 75 pounds per yard, 2·5 inches high, 2 inches wide at head, and 6 inches at base, laid in shallow cast iron chairs, which are spiked to sleepers 9 inches wide, by 7 feet long, placed at distances of 3·5 feet apart.

The wagons traveling over this road are of various patterns, and are, with a few exceptions, devoid of springs. Their weight, when empty, varies from 26 to 63 cwts., and when loaded, from 6 to 11 tons. The speed at which they are drawn varies, also, from 3 miles an hour, the speed of those drawn by horses, to 12 miles an hour, for those drawn by steam locomotive engines.

These rails have had the wear and tear from the passage of 4,783,000 tons of miscellaneous traffic, but, from their damaged condition, we cannot estimate their duration at more than 5,500,000 tons.

Case 9. Railroad for the conveyance of coal, consisting of a single track of parallel rails, weighing 40 pounds per yard, 3·87 inches high, 1·87 inches wide at the head, 1·2 inches wide at base, with centre web ·56-inch thick, laid in cast iron chairs pegged to stone blocks, weighing from 4 to 6 cwts. each, and placed at an average distance of 3 feet apart from centre to centre.

The wagons running on this road are drawn by horses at an average speed of 4 miles per hour, and are mounted on four cast iron wheels, 28 inches in diameter, turning loosely on their axles, which are bolted to the wrought iron frame of the wagon. They weigh, when empty, 3 tons, and when loaded, 5 tons 17 cwts.

The gross traffic over this line has amounted, during the 13 years which it has been open, to 8,626,000 tons, and it now remains in a good working condition. The duration of these rails may, therefore, be estimated at about 15,000,000 tons.

Case 10. Taff Vale railroad, for the conveyance of passengers, metals, minerals, and general merchandise, between Cardiff and Merthyr Tydfil. Upper section consisting of a single track of parallel rails of the single head form, weighing 50 pounds per yard, 4·5 inches high, 2·2 inches wide at head, 2 inches width of lower web, and ·66-inch thickness of centre rib or web, supported at intervals of 3 feet by chairs bolted to cross sleepers 10 inches wide by 9 feet long. The ballasting under the sleepers consists of a thick stratum of broken cinders.

The wagons and carriages running on this road, vary considerably in their weight—from 2 tons 10 cwts. to 4 tons 10 cwts. when light, and from 8 tons to 12 tons when loaded. They are furnished with wrought iron wheels and tyres, bearing springs and friction brakes, and the passenger carriages have buffer and draw springs. The locomotive engines employed, weigh about 20 tons, exclusive of tenders, and work at speeds varying from 15 miles per hour, for slow mineral trains, to 30 miles an hour, for passengers.

These rails have been in use nearly 13 years, and from the most careful computations, the traffic over them has been 5,400,000 tons. At the crossings and portions of the line where a considerable braking power is

applied, their depth is reduced, by abrasion, to 4·4 inches, but in all other respects, these rails are generally sound. Their duration may be estimated as equal to the rolling of 10,000,000 tons.

Case 11. Taff Vale Railroad,—the down-line from the Aberdare junction to Cardiff. Length of the line, 14 miles, and falls at the rate of 15 feet per mile. Rails of the parallel double headed section; depth, 5 inches; width of head and foot, 2·5 inches; centre web, ·75 inch thick; weight, 72 lbs. per yard. They are supported at intervals of 2 feet 9 inches by cast iron chairs firmly bolted to cross sleepers, 10 inches wide by 9 feet long. In all other respects, the formation of this road is similar to that of the upper section near Merthyr Tydfil.

The carriages and engines last described, work on this section also, and at similar speeds. It is traversed daily by 3 passenger, 1 mail, and numerous luggage, metal, mineral, and merchandise trains. The passenger trains average about 96 tons gross each, but the mineral and other trains sometimes exceed 1000 tons in weight.

From the annual traffic reports of this company, we find that in the eight years that these rails have been laid, the gross traffic which has rolled over them, amounts to 20,516,000 tons. Although this weight has caused considerable lamination and abrasion at the stations and on the sharpest curves, these rails are now in fair working order, and with attention to the sleepers and ballasting, they will last for the conveyance of as much more. Hence, their duration may be estimated as equal to the rolling of 41,000,000 tons.

Case 12. Taff Vale Railroad,—the up-line from the shipping port of Cardiff to the Aberdare junction. This line is of the same length, and is similar in its construction to the down line, with which it runs parallel throughout. It is traversed, also, by the same engines and carriages, but the coal and coke wagons pass over this line empty.

The rails are of the same date as those on the down line, and the gross weight which has rolled over them, amounts to 11,200,000 tons. Their general condition is very similar to those in the down line; and their duration may be estimated as equal to the passage of an additional weight of 11,200,000 tons, or a gross total of 22,400,000 tons. The greater weight traversing the down line, is owing to the large quantities of coal sent down for shipment; the wagons used in the conveyance of which, return empty over the up line to the collieries.

The rails on both sections having suffered nearly alike in lamination and abrasion, although one has sustained little more than half the rolling of the other, is accounted for by the circumstance of the gradient being just sufficient to enable the engines and loaded wagons to roll down the one line, while on the other the ascent with 90 or 100 empty wagons is accomplished with difficulty by engines having 18 inch cylinders. The abrasion and injury to the rails by the slipping of the engine wheels in ascending gradients, is probably equal to, if it does not exceed, that from the rolling of the traffic.

Case 13. Railroad for the conveyance of minerals to the Hirwain Iron Works, consisting of a single track, 3 miles long, of the 4 feet 8·5 inch gauge. Rails, of a parallel single head form, 4·25 inches deep, 2·5 inches wide at the head, and ·75-inch thickness of centre web. They

weigh 46 pounds per yard, and are screwed fast to single cheek chairs on massive stone blocks every 4 feet. The ballasting consists of blast furnace cinders, and dust from the coke yard.

The carriages are constructed of wrought and cast iron frames, and are mounted on 4 cast iron wheels 32 inches diameter, turning loosely on axles bolted firmly to the carriage frame. They weigh when light 2 tons 5 cwts., and when loaded, 5 tons, but are unprovided with any springs. The locomotive engines weigh 10 tons each when in running order, and propel the loaded carriages at an average speed of 10 miles an hour.

This road has been laid with these rails about 4 years. The gross weight which has passed over it in that time amounts to 1,055,000 tons. On carefully examining the state of the rails after this traffic, 23 per cent. were found laminated to an extent rendering their immediate replacement by sound rails indispensable; while the others cannot, under existing circumstances, last more than 2 years again. The duration, then, of the rails on this road may be estimated as equal to the passage of 1,318,000 tons, or considerably less than either of the previous examples.

In reference to the foregoing examples of the duration of railway bars under different conditions of laying and working, we may remark that in every instance where, in the construction of the permanent way, sufficient solidity has not been obtained by the employment of adequate sleepers, the destruction of the rails has been most rapid. This was the result with cases 1 and 6, and the effects are visible in 3, 4, 5, and 8. The greater duration of 11 and 12 over the others, must be ascribed to the use of heavy rails, wagons, and carriages with bearing springs, and a well constructed and carefully maintained permanent way. No. 12, is a very favorable instance of durability—probably, equal to any ever laid, which has principally resulted from the very favorable grade of the line. No. 10, with heavier rails, would have equalled No. 11, as the conditions are otherwise similar. The absence of bearing springs to all the wagons, except those in cases 10, 11, and 12, must also have had a very prejudical effect on the rails and greatly lessened their duration. In case 6, the rails were too weak, and the support unequal to the heavy wagons employed. Case 9, with heavier blocks and lighter wagons, is a very favorable specimen of a mineral railroad. Case 13, shows the most unfavorable results of the whole number detailed, but when the very inferior quality of the metal used and the defective nature of the fastening employed is fully considered, a different result could scarcely be expected.

In the tabular statement of the duration of the rails, it is supposed that the cost of labor and materials in replacing unsound bars and the ultimate expenses incidental to the entire renewal of the rails, when worn out, will be equivalent to the value of the old metal obtained. This is found to agree very nearly with the results obtained in practice.

We have in our possession, similar notes respecting the duration of cast iron rails, of which numerous examples may be seen at or in the neighborhood of Merthyr Tydfil; but the general abandonment of this material for that of wrought iron, would cause such notes of little value, if published.

Tabular Statement of the Duration of Iron Railroad Bars.

Number of case or example.	Weight of rail (in pounds) per yard.	Depth of rail, in inches.	Bearing surface presented by sleepers for each lineal foot of track, in superficial feet.	Greatest weight rolling on 4 wheels, in tons.	Greatest weight on a foot lineal of track, in tons.	Velocity of trains in miles per hour.	Motive power employed.	Gross traffic over a single track of rails before renewal, in tons.	Weight of rails per mile for a single track, in tons.	Cost of rails per mile estimated at 50 dollars per ton.	Number of tons carried over one mile of road for each dollar's worth of iron consumed.
1	56	2·5	·75	16	2·7	16	Locomotive,	1,822,800	88	4400	414
2	63	3·75	2·25	16	2·7	16	"	12,000,000	99	4950	2424
3	56	2·5	1·75	7·	1·2	12	Gravity,	4,043,500	88	4400	919
4	56	2·5	1·1	7·	1·2	3	Horses,	9,800,000	88	4400	2227
5	90	3·4	1·7	14	2·	8	Stationary,	8,000,000	142	7100	1126
6	55	5·	1·1	8·5	2·2	3	Horses,	1,628,640	86	4300	378
7	56	2·37	2 1	4·8	1·5	6	Stationary,	7,840,000	88	4400	1781
8	75	2·5	1·5	11·	2·4	12	Locomotive,	5,500,000	117	5850	940
9	40	3·87	2·5	5·9	1·3	4	Horses,	15,000,000	63	3150	4126
10	50	4·5	2·5	16	2·8	30	Locomotive,	10,000,000	78	3900	2564
11	72	5·	2·7	16	2·8	30	"	41,000,000	113	5650	7256
12	72	5·	2·7	16	2·8	30	"	22,400,000	113	5650	3964
13	46	4·25	2·	10	2·1	10	"	1,318,000	72	3600	363

For the Journal of the Franklin Institute.

Disquisition on the Laws regulating the Slips of Screw Propellers in function of Form and Dimensions; based on a Digest of the Experiments made in 1845 *by M. Bourgois, Engineer de Vaisseau, at the French Government Manufactory at Indret.* By B. F. Isherwood, Chf. Eng. U. S. Navy.

The following experiments on various screw propellers, were made in 1845, by M. Bourgois, Engineer de Vaisseau, at the government manufactory of Indret, in France; where he was furnished with the requisite manual force, a boat and a considerable number of experimental screws of different forms and dimensions. This was about the time that experiments were being made with the "*Rattler*," "*Archimides*," "*Napoleon*," and other screw vessels; it was in the very infancy of screw navigation, and before sufficient experimental data, on a large scale, had been obtained to indicate the proper proportions of a screw and the laws governing its mode of action. The necessity for a correct theory of the screw was pressing, for the above mentioned experiments on a large scale were neither sufficiently varied nor sufficiently accurate to furnish it; nor has this want been satisfied to the present time by any systematic experiments on the scale of actual practice, accurate enough and varied enough to resolve the various problems of the screw: and it is only by digesting together the many unconnected and occasional experi-

ments which have been made at different times, under different circumstances, by different persons and on different vessels, that we can now make an incomplete theory of the screw, and give an approximately correct answer to specific questions regarding it in function of form or dimensions. The power at the command of Bourgois was not of the kind that entitled him to furnish data for the formation of a complete theory of the screw; it consisted of the varying manual force of men impossible to be measured; he was therefore obliged to address himself entirely to the problem of slip, and this he solved very satisfactorily and with much sagacity of manner, if we consider the means at his disposal, and the scale on which he experimented; and to this day, I regard his experiments as among the most complete and systematic that have been made, losing nothing of their value by the lapse of time. His original report has never, to my knowledge, been published or referred to in English, and possessing a copy in French, I have carefully reviewed and examined the voluminous tables of detail embraced in it, and have extracted from them such data only as were consistent with each other and with the nature of things, rejecting a considerable mass of what was contradictory and evidently erroneous. The data so selected, and which I am persuaded from its close agreement with each other, and from the comparable manner in which it was obtained, is very accurate, I have made the ground of the present paper; the conclusions drawn, the accompanying remarks, and the arrangement are my own. I have drawn on the report for the original experimental data only. Owing to the want of knowledge of the power exerted with the different screws, this data is strikingly deficient when we attempt to ascertain either the relative economical efficiencies of the different screws as a whole, or to analyze the distribution of that power with a view to determine the value of the friction of the screw surface on the water. These important questions must therefore be left unanswered, and the sole problem resolved by the experiments, is, as before mentioned, the slips of the screw as affected by form and dimensions. The results, therefore, hereafter given, do not, it must be distinctly understood, indicate the relative economical efficiencies of the screws, but only their relative slips.

Objections may certainly be made to these experiments on account of the small scale on which they were conducted; but such objections, if closely examined, will be found more specious than real. And the very smallness of the scale, allowed the experiments to be so often repeated and varied, and with such a degree of exactness in the determination of all the elements of time and dimensions, as would be hopeless on a grand scale; where the number must necessarily be limited, the determination of the elements inexact, the labor immense, and all the difficulties and liabilities to error great. Experiments on a grand scale would be vitiated by many accidental circumstances impossible to guard against, and whose effect could neither be calculated nor eliminated from the general result. In confirmation of this, it is only necessary to refer to the experiments on the "*Rattler*," "*Dwarf*," and many other screw vessels.

Manner of Experimenting.—A convenient place was first selected on the river, where the bank was straight and the water nearly on a level

with it, and a base was marked out by two javelins or staves placed 328 feet apart, and ranging with other staves at right angles to this base. The experiments were conducted here until a rise in the river overflowed its banks, when a second similar base was marked out, but only 219·76 feet long. In order to be certain that the experiments made on the two bases were comparable, a screw, which had always given consistent results on the first base, was experimented with on the second base; the mean slip obtained on the first base was 38·7 per centum, on the second base 39·4 per centum; we are therefore warranted in assuming the results on both bases, as comparable, and this assumption is further confirmed by the according results of a great number of other experiments. One observer in the boat counted the number of revolutions of the crank shaft from the instant of departure to the instant of arrival, while another observer took the time elapsed between the same departure and arrival. Every care was taken to insure extreme accuracy; the base was run over forward and back, and the mean results taken to give the slip of that trial; this double course was again run, and the mean results obtained gave the slips; again, a number of double courses were so run with each screw, and not content with this, but to avoid error from inexactness in the form of the screw surface, each screw, after being first experimented with, was reversed on the shaft, and the number of trials repeated with the other face of the blades; the means of all the trials with both faces were taken to give the true slip of the screw. In the part of the river chosen for the two bases, the current was always very feeble. The screw shaft was geared to make 9·88 revolutions for each revolution of the crank shaft, which latter was turned by four sailors; there was a double set of gearing, the driving wheels of each set containing 44 and the pinions 14 teeth.

Of the Experimental Boat.—This boat was of iron and had the following dimensions, viz.

Length between perpendiculars,		26·26 feet.
Extreme breadth, (outside of iron,)		5·09 "
Depth of hold,		2·87 "
Draft of water, at which all the experiments were made,	forward,	1·35 "
	mean,	1·575 "
	aft,	1·80 "
Greatest immersed transverse section at above draft,		6·458 sq. ft.

A number of experiments, carefully made with a dynamometer to ascertain the resistance of this boat, gave 13·23 pounds avoirdupois, at a speed of 3·281 feet per second, or 2·237 statute miles per hour. A great number of experiments, employing the various screws, were also made to determine whether an increase in the speed of the boat affected the slip of the screw; or, in other words, if the slip of the screw was influenced by its rotary speed. This rotary speed was greatly varied, in some cases 70 per centum, but no greater variations of slip were observed than the slight discrepancies inevitable to all observations of this kind; sometimes an increased speed gave a slightly increased slip, sometimes a slightly decreased slip. There results from this, that within the limits of speed employed, viz., 4 statute miles and under per hour, the *resistance* of the boat was in the ratio of the square of its speed, requiring the *power*

to propel it to be in the ratio of the cube of its speed. It was found, by experiments with two screws, that the fouling of the immersed surface of the boat by the collection of slime, &c., during 15 days of repose, increased the resistance sufficiently to cause an increase in the slip of one screw from 35·6 to 38·6 per centum, and in the slip of the other screw, from 37·4 to 39·4 per centum. Before experimenting, therefore, care was always taken to clean the bottom of the boat. It was also found, that a slight rocking of the boat materially increased its resistance, and, consequently, the slip of the screw; for instance, a screw that gave a slip of 31·4 per centum with the boat steady, gave a slip of 33·4 per centum when it was slightly rocked.

Material of the Screws.—The screws of the first and fifth series were made of wrought copper beaten very thin. Those of the second, third, and fourth series, were made of tinned wrought iron and bound with two circles of iron wire around the periphery; the screws of these latter series were not full threaded, that is to say, the blades did not descend to and unite with the hub, but the interior part, or portion adjacent to the hub, was cut out in a manner that may be imagined by passing through the screw a cylinder of the diameter of the cut out part, and having an axis coinciding with the axis of the screw; the blades were attached to the hub by copper arms of sufficient size for stiffness; these arms must, necessarily, by their direct resistance, have somewhat increased the slip, but they could not influence the relative value of the slips of screws of the same series. The screws with curved generatrices and directrises were made of zinc beaten to the required form on a wooden die. The screws of the first and fifth series, I shall call "full threaded screws;" those of the second, third, and fourth series, I shall call "part threaded screws."

Definitions.—Before proceeding further, it will be proper to give a few definitions of the terms herein employed in relation to the screw; which when considered abstractly from solidity, that is to say, mathematically, and formed by lines and superficies only, is termed a *helicoid*.

Let any right line whatever be taken and called the *axis of the helicoid*. And let any other line, curved or straight, of definite length, be taken, lying at any inclination to the axis and with one extremity touching the axis; this line is termed the *generatrix of the helicoid*.

Now let the generatrix be kept at the same inclination to the axis, and let its outer end be moved with a rotary speed around the axis, while its inner end is moved simultaneously along the axis, it will generate a twisted surface, termed a *helicoid*. The length of the generatrix is the *radius* of the helicoid.

The outer extremity of the generatrix, during the generation of the helicoid, will describe a line curved in projection and in elevation: this line is termed *the helix of the helicoid*. The helix is the *directrix of the helicoid*.

When the generatrix has an uniform rotary speed around the axis and an uniform rectilineal speed along the axis, the distance it moves along the axis during the time it is making one revolution around the axis, is termed the *pitch of the helicoid*, and the helicoid so generated, is termed a *regular helicoid*. If the rotary and rectilineal speeds of the generatrix, or either of them, be not uniform, there will be generated a helicoid of

irregular pitch, that is, the generatrix will momentarily describe helicoids of different pitches, each pitch being what would have resulted had the corresponding momentary speeds been kept uniform for one revolution around the axis.

If, now, we suppose the generatrix to move along the axis with an uniform speed, while it moves around the axis with an uniformly decreasing speed, or vice versa, it will generate an *irregular helicoid*, having an uniformly increasing pitch, or an *expanding pitch*, as it is commonly termed.

If the helix of a regular helicoid be projected on a plane, that is to say, if the circumference and pitch be made the sides of a right angled triangle, the helix, which will be the hypotheneuse, will be a straight line, and such a helix is termed a *straight directrix*. But, if the helix of a helicoid of expanding pitch be similarly projected, it will, instead of being a straight line, be a curved line, and such a helix is termed a *curved directrix*.

Whether the helicoid have a *straight* or *curved generatrix*, depends, simply, whether a straight or curved line was taken for it. If a curved line be used, the helicoid will be concave on one face, and convex on the other.

If the mathematical right line, constituting the axis of the helicoid, be replaced by a cylinder, and a straight generatrix be used with the inner end kept tangent to the cylinder, an *oblique helicoid* will be generated, having an acute angle for one face, and an obtuse angle for the other. Such a generatrix is termed an *oblique generatrix*.

When the mathematical helicoid is formed of matter, it is termed a *screw*; the right line axis is replaced by a *hub*, and the superficies is replaced by a *thread*. When the thread is divided into two or more parts and placed around the hub, these parts are termed *blades*. *One convolution of the thread* is formed by exactly one revolution of the generatrix around the axis, and if viewed projected on a plane at right angles to the axis, would appear a disk: in such a case the *whole pitch* is said to be used. If any less portion of the thread than one convolution be used, *a fraction of the pitch* is said to be used.

Kinds of Screw.—The screws experimented with, were of the following kinds, viz.

1st. *Full threaded* screws with straight generatrices and directrices, formed of exactly one convolution of the thread, but having it divided into several blades.

2d. *Part threaded* screws with straight generatrices and directrices, formed of exactly one convolution of the thread, but having it divided into several blades.

3d. Full threaded screws with straight generatrices and directrices, formed of *fractions of the pitch*, and having the thread divided into several blades.

4th. Full threaded screw composed of a fraction of the pitch, with an *oblique generatrix* and a curved directrix.

5th. Full threaded screws with *curved directrices*, composed of the whole and of fractions of the pitch, with straight generatrices.

Objects of the Experiments.—With the above kinds of screw, it was

sought to determine the variation of slip *in fraction of the form* of the screw, as follows, viz.

1st. The influence exerted on the slip by cutting out the inner portion of the blades.

2d. The influence exerted on the slip by employing less than one convolution of the thread, or by fractioning the pitch.

3d. The influence exerted on the slip by employing an oblique generatrix.

4th. The influence exerted on the slip by employing a curved directrix, or expanding pitch.

5th. The influence exerted on the slip, by the division of the same propelling surface, into a more or less number of blades.

Subordinately to these, it was essayed to determine the influence exerted on the slip by surrounding the periphery of the screw with a drum of very thin metal, fastened to and turning with the blades.

Also, the influence exerted on the slip of the screw by placing the blades checkerwise, that is, by moving back the distance of the length of the blades and in a line parallel with the axis, half the blades of the screw; by which means the length of the hub will be doubled, and the screw will present the appearance of two similar screws on the same axis placed one immediately after the other, with the blades of the last intersecting the spaces between the blades of the first.

In function of the dimensions of the screw, it was essayed to determine the influence exerted on the slip :—first by the pitch, and second by the diameter.

Experimental Data.—Bourgois, in his voluminous tables, has entered all the detail of the experiments; such as the time elapsing between departure and arrival, number of revolutions made by the screw, speed of the screw, speed of the vessel, &c.; but it is obvious, that as the speed of the screw did not affect its slip, it is unnecessary here to occupy ourselves with such unimportant detail, whose only value consists in the fact of its furnishing the means of arriving at the final results we are in quest of. I shall, therefore, in the following tables, only include in addition to the dimensions of the screws, their mean slips, and their minimum and maximum slips; and the number of double courses ran with each screw, counting once forward and once back over the base as a double course.

In comparing the experimental data, the screws are of course supposed to preserve, when propelling in water, the same form they possess when in repose: nevertheless, they are subjected, when propelling to a strong force, directly to the alteration of their form. For it is a well known fact, which, beside, is fully established by these experiments, that the propelling efficiency of the blade rapidly diminishes as we pass from its anterior to its posterior edge; that is to say, considerably increasing the length of the blade, but slightly diminishes its slip. Now the slip of the screw, which is the difference between its longitudinal speed and the speed of the boat, measures simply the difference between the resistance of the vessel and the resistance of the water pressed by the screw; hence it follows, that when by lengthwise addition of surface to a screw its slip is but slightly decreased, additional surface experiences only a slight resistance from the water it presses corresponding to the slight decrease

of slip. The strain, then, of the water pressed by the screw instead of being equally distributed over the surface of the blade is principally at the front or anterior part, diminishing very rapidly as we approach the posterior part. Now, if the metal of the blades is made *very thin*, as in the screws of these experiments, and has not perfect stiffness, it is plain they will yield or spring back; and the anterior part having more strain upon it than the posterior part, will spring back more; consequently the angle made by the blades with the axis when propelling, will not be the angle when in repose, but a greater angle, giving the screw, when propelling, a greater pitch than it has when in repose. Were there no slip at all, and did the screw thread its way through the water as in a solid nut, it is plain that then every part of the blade, considered lengthwise, would experience an equal resistance from the water pressed: but in proportion as slip exists, so does the pressure at the anterior part increase disproportionately over that at the posterior part; for the greater the speed with which the water is set in motion (*i e.* the greater the slip), by the anterior part, the less pressure will evidently be impressed upon it by the posterior part following with the same speed as the anterior part. Hence we find, that the screws giving greater slips should have more alteration of form, that is, more increase of the pitch, when propelling than when in repose, than the screws giving lesser slips.

With regard to screws of different diameters; when the blades are made of metal so thin as to spring, it is clear, that the screws of least diameter will have the least alteration of pitch, because there is less strain upon them; therefore, in such screws the pitch will not increase when propelling so much as in screws of greater diameter over the pitch they have when in repose.

This alteration of the pitch of the screws when propelling from what they had when in repose, and which must have become permanent after the screw had been used a considerable number of times, owing to the excessive thinness of the blades, was quite overlooked by Bourgois, who was not a practical mechanician, and he proceeded to erect upon all the experimental data obtained, a number of empirical formulas involving the higher mathematics, for the calculation of the slips of screws of variously modified forms and dimensions. These formulas with the value of their elements controlled by assumed coefficients, will therefore apply only to cases where the blades spring the same as in his experiments, and where all the other accidents were likewise the same, and as they are not only false in themselves, but quite useless practically, it is unnecessary here, either to discuss or reproduce them. The results of Bourgois' experiments are certainly somewhat vitiated by the change of shape underwent by his screws when propelling from what they had when in repose, which latter forms, of course, the elements of comparison, but the vitiation is not so great in the data I have selected as to prevent these results from being, in my opinion, very valuable. Some of the screws are strictly comparable, and if in all cases the exact amount of influence exerted on the slip by different modifications of the form and dimensions of the screws is not determined, still a very close approximation is given, and the direction in which the changes operate clearly indicated.

In some of the experimental screws, the pitches are evidently erro-

neously given, and these screws I omit in the general tables, first and second, which include only those screws whose results are comparable. But as experiments were made with some of these omitted screws, which were strictly comparable with each other, such as reducing the number of blades one by one, cutting out the inner part of the blades, and shortening the length of the blades, I have discussed their results separately.

(To be Continued.)

Thirty-fifth general Report of the Chesapeake and Delaware Canal Company, June 5, 1854.

The President and Directors of the Chesapeake and Delaware Canal Company, in making their thirty-fifth annual report to this general meeting of Stock and Loanholders, have pleasure in stating, that the business, during the past year, has been conducted with regularity, and without accident or serious interruption to the constantly increasing trade.

The tow-paths, drains, and bridges have all been extensively repaired and improved, and the works generally are now in better condition for the transit of boats and vessels, than they have been at any time since the opening of the Canal.

From the statements of the Treasurer, herewith presented, it will be perceived that the revenue from tolls, for the year ending May 31, 1854, amounts to the sum of	$246,695·02
The contingent and incidental expenses, which include all items for repairs, interest on loans, officers' salaries, wages, and contingent charges, for the same period, amount to	$200,131·46
Leaving a surplus of (nett profits arising from tolls,)	$46,563·56

This surplus, under the provisions of the Charter, might be divided among the Stockholders, being the actual profits of the Company, above interest and expenses, arising from tolls; but in view of the present financial wants of the Company, growing out of the enlargement of its locks, it is recommended that no dividend be now declared, but that this amount may be carried to the credit of a dividend fund, that it may be kept, so as to be distributed among the Stockholders at some future day, when the Company may find it more convenient to do so than at present.

It is proper, in this connexion, to state, that to the clear income from tolls, as already stated, there may be added the further sum of $15,429·06, of revenue derived from interest, dividends, rents, &c. The total clear revenue would then stand as follows:

Revenue from tolls, ...	$46,563·56
" " other sources, ...	15,429·06
Total revenue, clear of interest and expenses,	$61,992·62

At the last general meeting of the Stock and Loanholders, the necessity for additional and larger locks was communicated to the meeting. By a resolution then adopted, the Board was authorized to undertake the necessary measures for the accomplishment of that purpose. The Board immediately proceeded to the execution of this important work.

Having secured the services of Ashbel Welsh, Esq., an eminent and distinguished Engineer, the surveys and necessary explorations, preliminary to the establishment of the sites for the new locks, were commenced and prosecuted, and after a full examination of the nature of the ground in which these locks were to be placed, the Engineer recommended to the Board, the location of two locks, one at St. George's and the other at Delaware City, on the south side of the present ones at those points, and the location of a single lock at Chesapeake City, on the north side of the two now at that place, having the same lift as both of them.

After a full consideration of all the circumstances connected with this important work, the Board came to the conclusion, that locks of 220 feet long by 24 feet wide were most advisable, and it was therefore decided to have them constructed of these dimensions. The plans and specifications having been prepared by our Engineer, proposals for the construction of the locks were advertised for, and the contract for them, under the direction and supervision of the Engineer, was awarded to Messrs. Candee, Dodge & Co.

The completion of these locks, though delayed beyond the time expected and contracted for, is now near at hand; the work has been a difficult one, requiring energy, skill, and constant attention to avoid serious accidents and interuptions to the trade of the Canal, but the Board have great satisfaction in being able to state, that they consider the works now so far progressed as to be free from all danger of casualty, and that pending their construction, up to this time, there has been no accident, and that the trade upon the Canal has not been interrupted for an hour.

The results of the year's business have been highly satisfactory—the receipts of the year ending May 31st, 1851, (the largest of any preceding year,) were unnaturally swelled by having not only the usual timber trade of that year, but a great portion of that of the prior year thrown into it, in consequence of the low stage of water in the spring of 1851 in the Susquehanna, which prevented the floating of timber.

Notwithstanding this, and the fact that owing to the very severe winter and late spring of the present year, which has deprived us of the ordinary trade on the Canal during these seasons, the receipts of this year slightly exceed those of the last year.

The Board, therefore, feel fully warranted in saying, that the business of the year just closed, exhibits the same general improvement, which has marked that of each preceding year; and, in assuring the Proprietors, that, after the completion of the new locks, which will give such important increased facilities, the business of the Company must and will continue to increase from year to year, for many years to come.*

To meet the expenditures for the construction of the new locks, and other expenses necessarily incidental thereto, it was deemed proper by the Board to increase the capital of the Company, by an additional Loan. At separate meetings of the Stock and Loanholders, held at the office of

* Between the opening of the Tide-water Havre-de-Grace trade and the first of June, instant, there have passed between Havre-de-Grace and Philadelphia, through the Chesapeake and Delaware Canal, 50,282 canal boats, without loss, excepting that which occurred to some two or three boats in a towage on the western end of the line, and in one or two other single instances of boats to a small extent.

the Company, on the 18th day of July, 1853, after due notice had been given of said meetings and of the purpose for which they were called, the propriety of obtaining the Loan was sanctioned and approved by a majority in interest of the whole number of Stock and Loanholders. A call for proposals for $250,000 of this Loan has been made, and proposals have thus far been received to the extent of $180,000, with every prospect that the balance will be taken by the first of July, before which time the money will not be needed.

ANDREW C. GRAY,
President Ches. and Del. Canal Co.

Philadelphia, June 3d, 1854.

AMERICAN PATENTS.

List of American Patents which issued from December 19th, 1854, to January 23d, 1855, (inclusive,) with Exemplifications.

DECEMBER 19.

73. For a *Feeding Apparatus to a Machine for Cutting Irregular Forms;* Charles P. Bailey, Zanesville, Ohio.

Claim.—"The hinging or pivoting of the rest to the table, and uniting the carriage that carries the block and pattern thereto, by means of a mandrel, which may be turned at pleasure by a helically grooved rod or shaft, for the purpose of cutting twisted or spirally formed pieces as they pass the cutter head."

74. For an *Improvement in Condensers;* Samuel W. Brown, Lowell, Mass.

Claim.—"1st, The lever valve, in combination with the inclined plane on the top of the movable lever, or with a stationary incline plane, for the purpose of opening this lever valve with an increased power when the condenser descends by the yielding of the tube to which it is attached, this yielding being caused by the weight of the water of condensation. 2d, Suspending the condenser by a tube of metal, or other substance, so remote from the bearing on which this tube rests, that it will yield or spring downwards by the weight of the water of condensation sufficiently to open a valve, or its equivalent, which allows of the escape of this water, and retains the steam."

75. For an *Improvement in Metal Separators;* Thomas J. Chubb, City of New York.

Claim.—"The arrangement of a series of guide plates or compartments above the sieve, a series of tubes or plates below the sieve which I call a sieve bed, the bellows for supplying the blast, the guide plates or scrapers."

76. For an *Improvement in Cleaning Seed Cotton and Feeding it to the Gin;* Major B. Clark, Newnan, Georgia.

Claim.—"The combination of a series of parallel bands, operating as a feeding apron, with a toothed roller, the teeth being so arranged on the roller as to pass between the feeding bands, whilst the arms of a beater are so arranged as to pass between the teeth of the said roller, and strip them of the cotton as it is carried forwards."

77. For a *Double Acting Force Pump;* D. W. Clark and S. H. Gray, Bridgeport, Con.

Claim.—"The combination of two pistons and piston rods with one pump barrel and one brake, when one of the rods is made to pass through the hollow interior of the other, and when both rods are connected with the brake by means of the connecting links and cross levers."

78. For an *Improvement in Bilge Supporters for Holding Vessels in Docks;* Horace J. Crandall, Boston, Massachusetts.

Claim.—"The making of bilge supporters with standards and braces, with rocker

movable joints, with the shieves or rollers, and rails for the bilge supporters to rest or move upon when not loaded, and for the use of dry sectional or railway docks."

79. For an *Improvement in Guards for Ferry Boats;* Daniel Fitzgerald, Thos. Rogers, and Wm. C. Walker, City of New York.

Claim.—"1st, The use of the cat head and connected apparatus to effect, at the arrival of the boat, the removal of the guard. 2d, The removal of the guard by the action of the boat against the apparatus. 3d, The self-closing of the passage by the withdrawal of the boat."

80. For an *Improvement in Clover Harvesters;* John S. Gage, Dowagiac, Michigan.

Claim.—"Gathering clover and other seeds from the standing stalks, by means of a hollow cylinder provided with a series of toothed bars, so that the teeth of said bar will, as the cylinder rotates, be forced outward through holes in front of the cylinder, and comb the seed and chaff from the stalks, the teeth being drawn within the cylinder when at its top, and the seed and chaff stripped from them, so that it may pass into the box or body."

81. For an *Improvement in Grain Mills;* George W. Grader and Benjamin F. Cowan, Memphis, Tennessee.

Claim.—"Regulating the feed by the combination of a spring and an eccentric jut."

82. For a *Direct Action Water Wheel;* Stephen Hadley, Jr., Lyman, N. Hampshire.

Claim.—"1st, The form and construction of my wheel, as follows: making the surface upon which the buckets are affixed concaved or bell-shaped, in combination with spiral-formed buckets, so curved as to meet the water on their face, perpendicularly to its course, and gradually diminishing their capacity from the centre to the periphery. 2d, The adjustable collar, bevel wheels, and gear wheel, combined to train and sustain the wheel, and adjust it perfectly to the stationary parts. Lastly, in combination with the above described wheel, the stationary cap inclosing the moving buckets."

83. For an *Improvement in Machines for Straightening Heavy Metal Bars;* Isaac B. Howe, Northfield, Vermont.

Claim.—"The combination of a lever beam, sliding fulcrum, operating screw, and sliding yoke or hold fast, whereby I am enabled to obtain the advantage of leverage, in combination with a screw power, for bending the rail when the machine is applied thereto."

84. For an *Improvement in Registering Dynamometers;* W. B. Leonard, City of N. Y.

Claim.—"The registering dynamometer for rotary motion, which is made up by the combination of an indicating dynamometer for rotary motion, with a registering apparatus, by means of a controlling connexion."

85. For an *Improvement in Sash Fasteners;* Charles Merrill, Malden, Massachusetts.

Claim.—"The arrangement of a wedge and its mortise plate with a spring bolt and its catch plate, so as to operate for the purpose of drawing the sashes together, when fastened with a spring bolt."

86. For an *Improvement in Making Sugar Moulds;* James Myers, Jr., City of N. Y.

Claim.—"Filling the space between the base band and the mould case with moulten iron, or other suitable metal, in such a manner that the metal, by uniting with the base of the mould case, will, when cooled, form a complete and durable armor for the same."

87. For an *Improvement in Composition for Tanning;* G. Reynolds, Bangor, Maine.

Claim.—"The above described composition, consisting of muriate of soda, alum, and sulphuric acid, this composition to be dissolved in water, for treating hides, or converting them into leather without depilating them."

88. For an *Improvement in Cut Nail Machines;* J. P. Sherwood, Fort Edward, N. Y.

Claim.—"1st, Connecting the tube to a vibrating carriage, and combining said tube and carriage with the sliding plate, the lever, the hook, the cam wheel, and shaft, in such a manner that the forward end of said tube will be elevated during the first half of its semi-rotary movement, and be depressed during the latter half of said movement, and then be firmly held in a depressed position a sufficient length of time for a nail to be cut from the nail plate. Also, the combination of the flaring jaws with the end of the tube, in such a manner that they can be so adjusted as to enable them to unerringly

guide a nail plate of any width to the cutters, when the machine is in motion, and allow the end of the nail plate holder to pass in between said jaws. Also, combining the nail plate holder with the arm, the rack bar, the spring, the pinion, the lever, the cam wheel, and the shaft, or their equivalents, in such a manner that the nail plate holder will be withdrawn at the moment that its semi-rotary movement commences, and will be pressed forwards at the moment that its semi-rotary movement ceases."

89. For an *Improved Method of Holding Vessels by the Keel in Dry and other Docks;* Jonathan Smith, Neponset Village, Massachusetts.

Claim.—"The arrangement of the keel pawl, as herein described; that is to say, a keel block which rests on and is confined to a bearer, and a pawl which slides in the straps or hasps, by which straps it is confined to the keel block and the bearer, a rope or chain attached to the pawl and led through a block to the side of the dock, by which the pawl can be hauled down; also, a rope attached to the pawl and led through a block to the side of the dock, by which the pawl may be raised."

90. For a *Shingle Machine;* John J. Speed, Jr., and John A. Bailey, Detroit, Michigan.

Claim.—"The combination of the reciprocating frames and feeding bar or catch, the reciprocating frames being provided with cutters, and the feeding bar or catch giving the shingles an accelerated motion while passing between the cutters."

91. For an *Improvement in Revolving Fans for Apartments;* L. Stein, City of N. Y.

Claim.—"Giving the combined revolving and flapping motion to the wings of a fan for cooling apartments, by having the wings hinged by one edge to arms projecting from a rotating shaft, and provided with crank arms, which, as the arms revolve, strike against fixed tappets or cams to give the flapping motion."

92. For an *Improved Clutch in Machines for Packing Flour;* Samuel Taggart, Indianapolis, Indiana.

Claim.—"The employment or use of the clutch formed of a cylinder or thimble, provided with a collar, and having studs or ribs on its inner periphery, which studs or ribs act against spiral flanches or ribs on the packing shaft, said cylinder or thimble having a constant rotating motion given it."

93. For an *Improvement in Life Preserving Seats;* Nathan Thompson, Jr., Williamsburgh, New York; patented in England, Sept. 18th, 1854.

Claim.—"The combination of adjustable buoyant bottoms with a buoyant top, whereby is constituted a life preserving seat."

94. For an *Improvement in Boot Crimping Machines;* Gray Utley, Chapel Hill, N. C.

Claim.—"The double row or series of independent and disconnected angular-shaped rubbers, placed opposite each other, and movable in horizontal guides to and from the centre, a spring behind each rubber effecting a gentle pressure upon the leather as it is pressed down between the rubbers by a crimping board, and each pair of rubbers retaining their pressure towards the centre, and from the edge of the crimping board upward, stretching the material until it shall have passed successively through the entire series."

95. For an *Improved Oven Cooking Range;* Daniel P. Weeks, Malden, Mass.

Claim.—"The arrangement and combination of flues, by which the smoke is carried around, and in contact with and made to heat the elevated oven of a cooking range, such causing the smoke to be led first against the rear half or portion of the under surface of the bottom plate of the oven, next against the front half or portion of the same, and in opposite directions to the two vertical sides of the oven, next upwards against the front half or portion of the external surface of each of the side plates of the oven, next downwards in contact with the remainder of each of the side plates of the oven, next into and upwards through a flue disposed directly against the rear surface of the rear end of the oven, and thence finally over and against the entire upper surface of the top plate of the oven, and thence through the discharge opening, the same enabling the oven not only to be thoroughly heated on its two sides, its bottom, top, and rear end, but to be so with a facility that insures quickness and strength of draft around it, whereby good combustion in the fire place is obtained and maintained."

96. For an *Improvement in Spring Bed Bottoms;* Wendall Wright, City of N. Y.

Claim.—"The manner of making the elastic bottom of bedsteads of wood, and in a

great number of square or other suitable shaped sections, in combination with the manner of arranging said sections."

97. For an *Improvement in Machines for Forging Horse Shoes;* Robert Griffiths, Allegheny City, and George Shield, Cincinnati, Ohio, Assignors to Robert Griffiths, Allegheny City, Pennsylvania.

Claim.—"1st, The arrangement of the sliding former and rising griper, or their equivalents, operating so as to gripe the car both edgwise and flatwise at its mid length. 2d, The spring projecting plates or cheeks on the one side of the dies of the bending jaws, acting in connexion with the face plate of the sliding shearing apparatus on their other side, for the purpose of preventing the metal from bending laterally whilst being turned around the former. 3d, The channelled bending jaws, for the purpose of confining the outer margin of the shoe during the process of grooving and punching, the side of the shoe being supported by the convex shoulders of the male former. 4th, The arrangement of the bending jaws and swaging die, for the purpose of imparting the desired relative width and thickness at every part, and of clamping it when thus formed, whilst it is grooved and punched by a separate die working around the swaging die. 5th, The retaining of the shoe in the gripe of the bending jaws by means of the cams which operate them having a portion of their periphery, the arc of the circle described from their centre of motion, or the equivalents of these devices, until the grooving and punching bits and male former are withdrawn, in order that the shoe may drop freely the moment it is released from said jaws."

98. For an *Improvement in Grain and Grass Harvesters;* Wm. F. Ketchum, Assignor to Rufus L. Howard, Buffalo, New York.

Claim.—"The enlargement of the driving wheel, for the purpose of changing the mowing machine to a reaping machine."

99. For an *Improvement in Leather Splitting Machines;* Elisha Pratt, Assignor to self and H. P. Upton, Salem, Massachusetts.

Claim.—"1st, The use of rolls, composed of sections of rings strung upon a shaft, in combination with the springs, or their equivalent, and when they are so united with the shaft which carries them, that while they are permitted to rise and fall to accommodate themselves to the varying thickness of the leather, they are at the same time forced to revolve with the shaft, and feed the leather into the machine. 2d, The feed apron, non-elastic in the direction of its length, and elastic in the direction of its thickness."

100. For an *Improved Machine for Turning Prismatic Forms;* Melton Roberts, Assignor to self and H. E. Pierce, Belfast, Maine.

Claim.—"The machine for turning prismatic forms, consisting of the cylinder of cutters, the mechanism for rotating the block intermittently, and for giving the transverse motion to the revolving cylinder, the whole operating automatically."

101. For an *Improvement in Sewing Machines;* Allen B. Wilson, Watertown, Conn., Assignor to W. P. N. Fitzgerald, Washington, D. C.

Claim.—"The device in a sewing machine for feeding the cloth along, consisting of a bar furnished with points or notches having a vertical or up and down motion for fastening the cloth upon and releasing it from said bar, by striking it against a plate or spring, and a lateral motion, or motion forward and back for feeding the cloth along after each stitch."

Re-Issue for December, 1854.

1. For an *Improvement in Seed Planters;* Moses and Samuel Pennock, East Marlborough, Pa., original patent dated March 12th, 1841; re-issued October 30th, 1849; re-re-issue dated December 9th, 1854.

Claim.—"The construction of the seed drill with the hopper, when both are worked, or raised and lowered independently of the body of the machine, so that both may be thrown into and out of operation at the proper time by one and the same movement, or mechanical means."

DESIGN FOR DECEMBER, 1854.

1. For *Box Stoves;* J. Stewart, Assignor to Cresson, Stuart & Peterson, Baltimore, Md.

Claim.—"The design for box stoves, as illustrated."

JANUARY 2*nd*, 1855.

1. For an *Improvement in Machines for Boring, Planing, and Slotting Metals;* N. Aylsworth, Rochester, New York.

Claim.—"The so arranging of the several operative parts of a machine for turning, boring, and cutting key seats in car wheels, cranks, and other machinery, as that the three several operations may be completed from the same centres, without unchucking said piece of machinery, by which means more perfect work can be done than when the piece is removed or re-chucked for two or more successive operations."

2. For an *Improved Apparatus for Feeding Paper to Printing Presses and Ruling Machines;* David Baldwin, Godwinville, New Jersey.

Claim.—"1st, Feeding sheets of paper singly, or one at a time, to a printing press, paper ruling, or other machine requiring the feed of a single sheet at a time, by means of a vibrating frame having at its lower end a series of tubes, which, as the frame vibrates, passes over the sheet to be fed to the machine, and also over a portion of the cylinder, or other device for receiving the sheet; a vacuum being formed and destroyed in said tubes, by means of an air pump attached to the frame, for the purpose of causing the tubes to convey the sheets from the feed table to the receiving device of the machine. 2d, The self-adjusting feed table, constructed and arranged so as to be operated by the vibrations of the frame, and keep the sheets close to the ends of the tubes. 3d, The tubes, arranged on a vibrating frame, when said tubes, with the aid of an air pump, are employed for conveying the sheets to the presser machine."

3. For an *Improvement in Constructing Vessels;* William Ballard, City of New York.

Claim.—"The construction of the bows and the sterns of vessels, in an O G form."

4. For an *Improvement in Looms;* Abram Brigham, Manchester, New Hampshire.

Claim.—"The mode of locking together and adjusting two or more cams on one shaft, viz: by means of the convexities and concavities applied to them, as specified. Also, the combination of the movable or sliding tappet and the extra cam or lip with each other on the main cam, or its shaft, and the treadle."

5. For an *Improvement in Grain and Grass Harvesters;* John E. Brown and S. S. Bartlett, Woonsocket, Rhode Island.

Claim.—"1st, Hanging or hinging the bar to the carriage so as to vibrate, in combination with the hanging or hinging of the cutter stock to the bar, so that the cutter stock may vibrate and accommodate itself to any undulations in the surface of the ground, and so that it may be raised by the attendant to pass stones, stumps, or other obstructions, without tripping the carriage."

6. For a *Dove-Tailing Machine;* Thomas H. Burley, Cincinnati, Ohio.

Claim.—"1st, The inclined fronting guide, in combination with the oblique cutting edges of the saw teeth. 2d, The double inclined tables, in combination with the series of vertical chisels."

7. For an *Improvement in Grain and Grass Harvesters,* Marshall Burnett and Chas. Vander Woerd, Boston, Massachusetts.

Claim.—"Making the same shaft or axle which serves to drive the cutter rods, cutter, or cutters, serve also as the pivot or centre of the joint between the cutter bar and the carriage, thereby preserving the proper relation between the cutter or cutters, and their driving mechanism."

8. For an *Improvement in Locks for Fire Arms;* J. S. Butterfield, Philadelphia, Pa.

Claim.—"The combination of the sear with the cam, the latter operating in the slot of the main spring."

9. For an *Improved Trap for Catching Animals;* J. Caffrey, Paradise Township, Pa.

Claim.—"The peculiar arrangement and combination of the lever, spring, and wire grating, acting simultaneously with the revolving platform, to cause the trap to act and set itself."

10. For *Construction and Mode of Driving Circular Saws;* Thomas J. Flanders, Manchester, New Hampshire.

Claim.—"1st, Supporting a circular saw edgewise, and operating it at the same time, by means of two spur gears, or their equivalents, arranged and operating at right angles to the saw, so that the said gears act upon the plate of the saw between the teeth, or through holes in the plate, to propel and support it edgewise at the same time, as described, thereby dispensing with the shaft, or its equivalent, heretofore used to propel and support the saw. 2d, Crimping or corrugating the plates of saws, so that they will require little or no setting, and to make them stiffer, also that the bends may run in contact with the sides of the score-cut, and support and steady themselves, so as to be less liable to be swerved by knotty, cross-grained, or hard places in the wood or material sawed, and at the same time run with less friction and power. 3d, Making the teeth of crimped or corrugated saws separate from the plate, and fastening them into the recesses formed by the crimping or corrugating, or between the bends in the plate of the saw, so that the saw may be supported and steadied by roller guides, or otherwise. 4th, Making the teeth of saws one-half the thickness of the plate or less, by taking off the side of the tooth, and the opposite side of the next tooth, as described, so that they will cut one-half or less than one-half the thickness of the saw kerf, so that the saw will run at a higher speed without heating, and execute a given quantity of work with two-thirds or less of the power heretofore required."

11. For an *Improvement in Churns;* Ezekiel Gore, Bennington, Vermont.

Claim.—"Making the pins with their inner ends flat, and so arranging them that they may be turned to the right or left, as desired, and thus made to present a large or small resisting surface to the agitated cream, and facilitate or retard the production of butter."

12. For an *Improvement in Machines for Cutting out Boot and Shoe Soles;* Jesse W. Hatch and Henry Churchill, Rochester, New York.

Claim.—"Giving the cutting knife or punch, half a revolution on its axis after every cutting operation, by any suitable mechanical means, for the purpose of reversing its position for the next cut, and thereby, when its ends are of unequal width, preventing the waste which, without some such provision, would be unavoidable."

13. For an *Improvement in Compensating Balances for Time Keepers;* Charles W. Hawkes, Boston, and George P. Reed, Waltham, Massachusetts.

Claim.—"The compensating lever, or its equivalent, in combination with the radial arms."

14. For an *Improved Apparatus for Atmospheric Pile Driving;* Alex. Holmstrom, City of New York.

Claim.—"1st, Constructing the 'air lock' in such manner that the pressure of the air either within the lock or within the hollow pile may be governed by the workmen inside, whereby they are thus enabled wholly to control the means of escape for themselves. 2d, Combining with the air lock a hoisting apparatus, to which the moving power is given from the outside of the lock, but the application of that power to the windlass is made by the workmen within, whenever the same may be required, whereby those men are not only relieved from any extra exertion, but the ability is also maintained of applying greater force than could be done were the motive power given from within."

15. For an *Improvement in Railroad Chair Machines;* J. B. Harris, Cincinnati, O.

Claim.—"1st, The holding plate and the leaf with the slots, and the block with the screws, in combination with the crank cutters. 2d, The cutter with salient cutting edges, thus making the cut concave in its length."

16. For an *Improvement in Cotton Gins;* Asa P. Keith, Bridgewater, Mass.

Claim.—"The slanting circular openings through the brush heads, with the guide flanches on the inside."

17. For an *Improvement in Machines for Forming Flanches on Wrought Iron Beams;* Julius H. Kroehl, City of New York.

Claim.—"The combination of the wide and narrow rollers and flanched rollers, which have a movement in the line of their axis corresponding with the desired form of the edges of the flanches on the beam, for the purpose of finishing or smoothing the said edges."

18. For *Cutters for Tonguing and Grooving;* Hazard Knowles, City of New York.

Claim.—"Forming, tonguing, and grooving cutter heads of combined disks of steel, which have cutting edges formed on their peripheries, of such a shape that new cutting edges can be formed upon them as the old wear away, without reducing their diameters."

19. For an *Improvement in Machines for Forging Car Wheels;* Wesley M. Lee, City of New York.

Claim.—"Forming the face of the hammer die with flutes or projections, substantially as specified, when combined with the turning of the die or anvil during the operation of forging or swaging."

20. For an *Improvement in Constructing Pavements;* Jean Francois Le Moulnier, City of New York.

Claim.—"Effecting the thorough union of the asphalte compound, or any equivalent therefor, and stone, by heating the block of stone previously."

21. For a *Shingle Machine;* Adrian V. B. Orr, Steeleville, Pennsylvania.

Claim.—"1st, Constructing the frame or slide of the splitting knife with two faces, the one being the thickness of a shingle in advance of the other. 2d, The device of raising the shaving knife from the platform during its back motion, for the purpose of allowing room for the introduction of the piece to be shaved. 3d, Moving the hold-fast up and down by the means described, so as to have its use when wanted, and then removing it out of the way of the finished shingle in its descent."

22. For an *Improvement in Regulating the Size of Rooving;* Samuel Pearson, Jr., and William H. Gardner, Roxbury, Massachusetts.

Claim.—"The combination of the brake, (forced downwards by a spring, or its equivalent,) the brake wheel, the shafts, and the connecting gearing of such shafts, as applied to the draw rollers, and the gill or hackle belt."

23. For an *Improvement in Processes for Extracting Tannin from Leather;* Obadiah Rich, Cambridge, Massachusetts.

Claim.—"The process for the removal of tannic acid from leather, and the subsequent preparation of the skin for making glue, by the use of ammonia, potash, or soda, of which the soda is preferred as the cheapest."

24. For an *Improvement in Signal Flags;* Henry J. Rodgers, Baltimore, Maryland.

Claim.—"The square signal flag with diagonal symbols, so that the same flag shall answer for signals in a high wind and in a calm."

25. For a *Machine for Splitting Rattans into Strips;* S. Sawyer, Fitchburg, Mass.

Claim.—"A combination of mechanism for splitting the rattan into sectoral strips, and a mechanism for running annular or symmetrical strands therefrom. Also, a combination of mechanism for splitting a stick of rattan into sectoral or triangular parts or strips, and a mechanism for rounding and dressing or finishing either one or more such strips. Also, a combination of mechanism for splitting a rattan in sectoral parts or strips, a mechanism for removing or separating from such parts annular or symmetrical strands, and mechanism for rounding, reducing, or finishing either one or more or all of the triangular strips or parts of the pith or inside portion of the rattan."

26. For an *Improvement in Processes for Making Soap;* Richard A. Tilghman, Philadelphia, Pennsylvania.

Claim.—"The manufacturing of soap by subjecting a mixture of fatty matters and solution of carbonated alkalies to a high temperature and pressure."

27. For an *Improvement in Life Preserving Rafts;* F. Z. Tucker, Brooklyn, N. Y.

Claim.—"The manner of connecting such buoyant cylinders, by passing rods through

tubes at right angles, and secured by nuts, in connexion with the straps or bands, whereby I make a strong, convenient, and ever ready life preserving raft."

28. For an *Improvement in Process for Making India Rubber Cloth;* Henry G. Tyer and John Helm, New Brunswick, New Jersey.

Claim.—"The peculiar mode of preparing the uppers of boots and shoes."

29. For an *Improvement in Sheet Iron Blinds;* Wm. E. Ward, Port Chester, N. Y.

Claim.—"The manufacture of Venetian blinds of sheet metal, bent in the form and united in the manner specified."

30. For an *Improvement in Sewing Machines;* Daniel J. Ward, Newark, N. Jersey.

Claim.—"The sliding fork, with or without the bristles, to detach the thread from the sides of the needle, or from a guide to the loop, for the passage of the looper or shuttle."

31. For an *Improvement in Protecting Slides and Ways from Dust;* E. H. Foote, Hartford, Connecticut.

Claim.—"The combination of the flexible guards which inclose the ways of slides in machinery, with the cross-head and the clasps, or their equivalents."

32. For an *Improvement in Tanning Processes;* Rufus Keeler, Rochester, Assignor to Lewis C. England, City of New York.

Claim.—"The improved method of tanning leather by introducing oil into the tanning liquor, and effecting its incorporation with the leather, in combination with the tannin."

33. For a *Machine for Manufacturing Wooden Boxes;* Louis Koch, Assignor to Theodore Rincus, City of New York.

Claim.—"1st, The means of making different sized boxes on the same machine, by the mere change of the cams and the pulleys, corresponding to the size of boxes to be made. 2d, Cutting off the boxes when finished, by tools fastened to spindles, said spindles being attached to the tool holders, and worked by an arm fastened on the end of the spindles. 3d, The construction and application of the frames with cones, respectively attached, actuating through the arms, the spindles, and consequently the tool, said frames being worked by cams and levers. 4th, The arrangement and connexion of the supports, provided with shafts and ratchet wheels, between which latter the wood out of which the boxes are to made is held, said supports being worked by cams and levers for feeding the wood to the tools, and releasing the same 5th, The construction of the pulleys worked by cams and levers, as well as by weights, said pulleys, when connected, acting upon the upper shafts running in the supports for approaching the wood up to the tool holders, after the completion of each set of boxes."

34. For an *Improvement in Curtain Fixtures;* Peter H. Niles, Assignor to self and Jonathan A. Richards, Boston, Massachusetts.

Claim.—"Arranging the spring in that chamber of the bracket in which the body of the pulley slides. Also, so arranging the secondary or lesser chamber, *g*, with respect to the chamber, *e*, that the spring may extend into both chambers."

35. For an *Improvement in Composition for Unhairing Hides;* Andrew H. Ward, Jr., Assignor to self and Kirk Boolt, Boston, Massachusetts.

Claim.—"The application of a compound solution of carbonate and sulphate of soda, to hides and skins, for the purpose of loosening their hair, and preparing them for the reception of tannin."

36. For an *Improvement in Seed Planters;* Alexander Anderson, Markham, Canada.

Claim.—"The peculiar construction of my seed planter, by which the apertures are made to perform the double function of carrying a graduated amount of seed to the discharge spout, and also to receive the teeth of the wheel, by which motion is communicated to the endless apron."

37. For an *Improvement in Self-Sealing Preserve Cans;* R. Arthur, Washington, D.C.

Claim.—"A vessel made with a groove to surround its mouth, prepared with cement, and ready for hermetical sealing; but to hermetical sealing itself I make no claim."

38. For an *Improvement in Journal Boxes for Carriages;* S. B. Bachelor, Lowville, New York.

Claim.—"The mode of constructing the stationary inseparable united recess in the pipe, in combination with the single adjustable axle shoulder band and sand band, with the cap and screw, or in any other manner substantially the same, by which I am enabled to use any axle of the common manufacture."

39. For an *Improvement in Suspended Purchases;* Wm. H. Brown, Erie, Pennsylvania; patented in England, October 2d, 1854.

Claim.—"In combination with a permanently suspended cable, a carriage provided with suitable block and tackle, by which a suspended weight of any kind may be transported to any given point, and then lowered or raised, or by which it may be lowered or raised as it is transported, at pleasure. Also, in combination with a suspended cable, a trunk or carriage composed of a main wheel, guide wheels, and a flexible frame, so that the wheels may adjust themselves to the line of the catenary. Also, the automatically coupling and uncoupling of the blocks. Also, the system of equalizing beams, when combined with two, three, or more cables, for the purpose of evenly distributing the weight upon the several cables."

40. For an *Improvement in Teeth;* Sharpless Clayton, West Chester, Pennsylvania.

Claim.—"The dove-tail grooves formed in the base of the teeth, and the holes through the teeth, said groove and holes to be filled with pure tin, cadmium, or any other fusible metal, so as to form a dove-tail flanch and pins, for the purpose of securing the teeth and gums to metallic plates."

41. For an *Improvement in Apparatus for Stereotyping;* Willard Cowles, Washington, District of Columbia.

Claim.—"The use of furniture of an exact and proper height, for the purpose of forming a bed in and around the mould, on which to place the metallic casting frame, which gauges the size, form, and bevel of the stereotype plate, or which shall itself form a support on which bars are placed, for the purpose of being pressed into the mould and imbedded therein, thus taking the place of the frame. Also, the use of a frame placed upon a bed in and around the mould, or in its place, the use of bars pressed upon and into the mould. Also, the use of slips of metal, or other substance, for the purpose of dividing the plate into two or more pieces."

42. For an *Improvement in Ox Yokes;* Levi Dederick, Albany, New York.

Claim.—"The flanched thimble for securing the centre bolts of separate vibrating neck blocks from the upper side, and thus avoid perforating the wood on the underside which rests upon the neck of the ox."

43. For *Composition for Fuel;* St. John O'Doris, Philadelphia, Pennsylvania.

Claim.—"The formation of an artificial fuel, by the combination of street garbage with coal dust, coal ashes, saw dust, and coal tar, or other bituminous substance."

44. For an *Improvement in Fermenting Tuns for Beer;* Adolph Hammer, Phila., Pa.

Claim.—"The application and use of the adjustable cover and the conduit pipe, in combination with the tun, or any other suitable vessel."

45. For an *Improvement in Fire Proof Iron Buildings;* Emanuel Harmon, Washington, D. C.

Claim.—"The insulation of the skeleton frame work of iron buildings from the exterior and interior coverings of said frame work with their fastenings or attachments, by the interposition of a non-conducting substance, such as plaster of paris, soap stone, or felt, in combination with an air space, or sheets of plaster of paris, felt, or other incombustible non-conducting substance. Also, the above insulation, in combination with the entire filling up of the space between the said exterior and interior coverings or surfaces with any incombustible non-conducting substance."

46. For an *Improved Mode of Hanging the Knife in Planing Machines;* M. G. Hubbard, City of New York.

Claim.—"Hanging the first knife on arms projecting from the stock, horizontally or nearly so, by which it is attached to the frame."

47. For an *Improvement in Cultivators;* John Imel, Liberty, Indiana.

Claim.—"The curved and adjustable guard or fender hinged to a tongue supported upon running gear."

48. For an *Improvement in Machines for Cutting and Turning Slate;* Asa Keyes, Brattleborough, Vermont.

Claim.—"The combination of the cutters or hammers on the fly wheel with the circular dog, in direct contact with which each successive portion of the slate rests, to receive the blows of the cutter while the slate is fed up by a carriage on the ways."

49. For a *Machine for Blowing Blasts, &c.;* P. W. Mackenzie, Jersey City, N. J.

Claim.—"The use of the drum and blower, having centres eccentric to each other, the said blower being internal of the drum, and propelled by it. Also, the cylindrical adjustable packing for the arms of the blower, in combination with the drum and blower arms."

50. For an *Improvement in Steam Railroad Car Brakes;* Henry Miller, City of N. Y.

Claim.—"1st, The arrangement of the cylinder, the pipe, and the branch pipe of each car, to wit: the pipe inclining downwards from each end of the car, and the branch pipe inclining downwards from the lowest point of the cylinder towards the point of junction with the said pipes, so that the condensed water may all run from the pipes and cylinder, and escape therefrom, or be conveyed into a suitable receptacle provided with proper means of escape. 2d, Encasing the piston rod with a flexible tube, which is attached at one end to the rod, and at the other to the cylinder head, and is kept extended so as not to be injured by the working of the rod, by means of a spiral spring surrounding the rod, which said spring assists in returning the piston and freeing the brakes after the steam or compressed air is shut off."

51. For an *Improvement in Fruit Dryers;* R. S. Morse, East Dixfield, Maine.

Claim.—"The constructing a portable fruit dryer of a series of trays, and a protecting roof, united to each other by hinging bars."

52. For an *Improvement in Elevating Scaffolds;* F. Rudolph, City of New York.

Claim.—"The arrangement and combination of the centre pole and the scaffold, the former being usually placed within, and the latter about the structure to be built, each of which may be elevated, as desired."

53. For an *Improvement in Rakes;* Emile Sirret, Buffalo, New York.

Claim.—"1st, A revolving rake, having the head made in two sections. 2d, In combination with the same, the employment and arrangement of the jointed forked treadle."

54. For an *Improved Method of Hanging a Path-Finding Saw;* John A. Taplin, Fishkill, New York.

Claim.—"The pendulum block to support and guide the upper end of the saw."

55. For an *Improvement in Composition for Dressing Leather;* Cuno Werner, Philadelphia, Pennsylvania.

Claim.—"The use or employment of a compound for dressing leather, composed of a saturated infusion of oak bark, (or other substances affording tannin,) train or fish oil, rosin, hog's lard, and creosote."

56. For *Improvements in Cast Iron Pavements;* C. Warner, City of New York.

Claim.—"The bars, connected, sustained, and bound together by the keys or cross pieces."

57. For an *Improvement in Hats;* Wm. F. Warburton, Philadelphia, Penna.

Claim.—"Forming the rim of hats with corrugations, channels, or grooves, or other ridges, or other form, for imparting strength, softness, and elasticity to the rim, with less weight of felt, or other material, and a decreased quantity of stiffening substance of which it is composed than is ordinarily employed in forming rims, the said rims being previously, or at the same time such corrugations, grooves, or channels are formed, slightly raised or arched at the front and back parts immediately next the body or crown of the hat, and depressed or slightly curved downward at the sides, or not, as fancy or taste may dictate, to give them the proper brace or set."

58. For an *Improved Machine for Cutting Irregular Forms;* Warren Wadleigh, Hill, New Hampshire.

Claim.—"1st, A reciprocating cutter with one or two edges, guided or governed by one or more patterns, so as to cut the rough blocks or pieces of wood or other material, into the form required. 2d, The wedges, or their equivalents, so constructed and arranged as to enable the operator to vary the distance between the pattern and the cutter bar while the machine is in motion."

59. For an *Improvement in Machines for Making Weavers' Harness;* J. S. Winsor, Providence, Rhode Island.

Claim.—"The mode of operation, by means of which each twine is formed in a loop, and the spool, or its equivalent, conveying such twine, carried through such loop to form a knot, and then the spool, or its equivalent, which carries the other twine passed through such loop, that the twine thus carried through may be griped therein when the knot is drawn tight, thus forming the eye of two twines with a knot in each griping the other twine. Also, the mode of operation for determining the size of the eyes by closing the knots on the two fingers, or their equivalents, whereby the knots are closed at the proper place on each twine, the two sides of each eye made of equal length, and any desired number of eyes of the same size. Also, in combination with the fingers, or their equivalents, on which the knots are closed, the discharger, or any equivalent therefor, by means of which the knots are discharged from the said fingers as they are drawn tight. Also, the combination with the mechanism for forming the knots, the employment of pincers, or any equivalent therefor, for holding the twine tight after the knots at each end of the eye have been closed, and during the operation of drawing the twine tight around the band. Also, the mode of operation, by means of which the twines are wrapped around the bands in succession, and formed each into a loop through which the spool, or its equivalent for carrying the twine is passed to effect the tie. Also, the mode of operation for forming what is termed the leese of the harness, by reversing the motion of the spools, or their equivalents, for carrying the twine, thus carrying the twine alternately on opposite sides of one beam. Also, the method of mounting the heddles as they are formed on the slats or rods above the machine, and attaching the bands to which the heddles are tied in the process of formation, to a sliding bar, or its equivalent, which is elevated as the heddles are formed. And, finally, the method of marking every nineteenth, or any other number of heddles, by means of the marker receiving motion."

60. For a *Sawing Machine;* Lysander Wright, Newark, New Jersey.

Claim.—"The two pulleys varying in size, the revolving guide block, the arrangement and combination of the guides, cross-head, hold-fast, and guide block, shoe, and screw, for the purpose of raising and lowering."

61. For a *Burglars' Alarm;* Daniel Wells, Philadelphia, Pennsylvania.

Claim.—"The radial arm with its projection, and the latch with its notched recess, for effecting the disengagement of the spring bolt on the movement of a door, or its equivalent."

62. For an *Improved Press for Printing Different Colors;* S. Brown, Syracuse, N. Y.

Claim.—"1st, The employment or use of a series of platens, (two or more,) so that the form or type on said platens may be inked simultaneously with separate and distinct colors, and operated or pressed simultaneously against the sheet. 2d, The arrangement of the cam, bent levers, and arms which are connected to the bent levers, for the purpose of operating the movable bed or platen, ink roller, and fingers. 3d, Operating the fingers by means of the screw and revolving bar, whereby the fingers are made to convey the sheet to and from the platens."

63. For an *Improved Arrangement in Double Piston Steam Engines;* W. S. Burgess, Norristown, Pennsylvania.

Claim.—"Having two pistons placed within one cylinder, the pistons being attached to rods, or their equivalents, so as to be a requisite distance apart, and attaching the connecting rod directly to the rods, or their equivalents."

64. For an *Improved Chuck for Turning Elliptical Cylinders;* Pulaski S. Cahoon and S. F. Ross, La Grange, Missouri.

Claim.—"1st, The arranging of the ring upon the sliding standard, and combining it with the lathe spindle by means of the slide. 2d, Arranging the slide between the face plate and standard, instead of attaching it to a ring situated back of the face plate."

65. For an *Improvement in Grinding Mills;* Amory Felton, Troy, New York.

Claim.—"The combination of the cylinder, concave, cap, and reciprocating teeth or fingers, the concave and cap being provided with spiral flanches."

66. For an *Improved Paint Brush;* Wm. Hicks, Steubenville, Ohio.

Claim.—"1st, The arrangement of the brush holder with the reservoir handle, regulating valve, end branch or feed, conveying the color on to the top of the brush. 2d, In combination with the self-feeding paint brush or pencil, the adjustable guide roller to facilitate the run of the brush in its desired course, and at a speed corresponding with a free flow and a continuous supply of color to and on the brush, and serving to form a rest at various angles of operation or hold of the brush; the said roller being arranged to run on the outside of the lateral spread or splay of the brush, and on the off side of it."

67. For an *Improved Printing Press;* Sidney Kelsey, Erie, Pennsylvania.

Claim.—"1st, Feeding or conveying the sheets to the form by having the carriage formed of two parts, and arranged so that the edge of the sheet may be grasped between the two parts of the carriage as it is moved between the platen and bed. 2d, The fly, operated by means of the pulley attached to the carriage by a cord, said pulley being hung on the shaft which is provided with a spring."

68. For an *Improvement in Folding Life Boats;* C. Locher, City of New York.

Claim.—"Connecting the folding ribs by means of a chain or chains being applied, to spread all the ribs at once, and when spread, to serve the purpose of keeping all in place."

69. For an *Improved Printing Press;* James Lewis, Prattville, New York.

Claim.—"1st, The employment or use of the fly. 2d, The combination of the fly, cylinder, and bed."

70. For an *Improvement in Padlocks;* Thomas Slaight, Newark, New Jersey.

Claim.—"1st, The employment or use of a dog, so that the pressure of the shackle upon it, when the end of said shackle is forced into the case, will throw the dog into the recess or notch in the shackle without the intervention or aid of a spring, or any other device. 2d, The combination of the dog, guard bar, with the stud, upon it and slotted tumblers."

71. For an *Improved Crank Connexion in Double Piston Steam Engines;* J. Smith, Cincinnati, Ohio.

Claim.—"The employment or use of two pistons, connected by a cross head or plate which has a slot through it, in which the crank of the shaft fits, whereby the pistons are directly connected to the crank, and a rotary motion given to the shaft without the intervention of the usual piston and connecting rods."

72. For an *Improved Brace for Piano Frames;* Dwight Gibbons, Assignor to Frederick Starr, Rochester, New York.

Claim.—"The making use of a diagonal brace, extending above the plate and strings."

73. For an *Improvement in Repeating Fire Arms;* Joshua Stevens, Chicopee Falls, Mass., Assignor to the Massachusetts Arms Company.

Claim.—"So combining the trigger, the hammer, and the mechanism for rotating the cylinder, that by a single pull on and during the back movement of the trigger, the hammer shall be discharged or set free from the trigger, (so as to fall on the nipple when the touch-hole of one charge chamber of the cylinder is in connexion with it,) and the cylinder subsequently rotated so as to bring up to the percussion nipple, or its equivalent, the touch-hole of the next chamber of the series thereof. And, in combination with the mechanism for turning the cylinder, and that for locking and unlocking it, I claim a cam pin, (projecting from the hammer,) or its equivalent, for preventing the cylinder from being unlocked, or for locking it in case the movement of the trigger is so rapid as to render the cylinder liable to be rotated before the charge fired by the action of the hammer has left its chamber. The arrangement and combination of the trigger and its spring, a rotary tumbler separate from the trigger, and moving on a separate pin or fulcrum, a turning mechanism of the cylinder, and the locking and unlocking mechanism thereof, by which arrangement and combination, during and by a back and forward movement of the trigger, the cylinder will be locked or unlocked, and have an inter-

mittent rotary motion imparted to it, and the cock or percussion hammer be actuated. Also, the bearer, *x*, or its equivalent, in combination with the turning lever, L, and the part or tumbler to which it is connected or jointed, and by which motion is imparted to the said turning lever."

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74. For an *Improved Propeller;* Charles De Bergue, Dowgate Hill, London, England; patented in England, April 6th, 1854.

Claim.—"An apparatus or blade, so oscillating or rocking in water, or other fluid, on a centre or axis worked to and fro, that each of its opposite sides shall alternately present a moving inclined face or surface to the fluid on which it acts, so as to force, displace, or propel the same, or a body floating thereon, such apparatus or blade working or rocking within a case or chamber through which the fluid acted upon is thereby caused to pass, or conversely in which the fluid is passing, may act on the blade."

75. For an *Improvement in Machines for Crushing and Pulverizing Ores;* Arnold Buffum, Perth Amboy, New Jersey.

Claim.—"The rocking action of the crusher, in combination with corrugations on the lower surface of the rocker, and corresponding corrugations on the upper surface of the bed plate."

76. For an *Improved Machine for Turning Irregular Forms;* William J. Casselman, Vernon, New York.

Claim.—"The particular mode of arranging and combining a pattern table, two or more work tables, a tracer, and a number of cutting tools to correspond with the number of work tables; that is to say, the work tables and pattern table being arranged with their axes in the same plane, and the tracer cutting tools and the levers which connect them being all attached in such a way to receive a carriage which has a movement in a direction perpendicular to the axis of the revolving tables, but parallel to the plane of the said axes, that the points of the cutters and tracer stand in the same plane, or in a plane near to and parallel with the plane of the axes of the tables, and will all bear at all times the same relation to each other, and to the pattern and work."

77. For an *Improvement in Candle Mould Machines;* L. C. Ashley, Troy, N. York.

Claim.—"1st, The apparatus for centering, cutting, and holding the candle wick, said apparatus being constructed of stationary and adjustable plates, with centering and cutting notches on the stationary plate, and holding or tightening notches on the adjustable table. 2d, The wick tightener for tightening the wicks."

78. For *Improvements in Machines for Making Nuts and Washers;* Robert Brayton, Buffalo, New York.

Claim.—"The arrangement of the forming box and case, secured by the plate to the thread block, operated by the piston in the cylinder, in their relation to the check, check-bars, punch, and die. 2d, The metallic plates, as arranged in the slides, in relation to the head block. 3d, The spring gauge bar, the same being to protect the bed die from the heat of the blank or nut bar, and also to gauge its feed."

79. For a *Stop Cock;* David A. B. Coffin, Lynn, Massachusetts.

Claim.—"The arrangement of a rocking lever, so that if turned either way by the hand, it will open the valve and be in such a position that when the hand is removed the valve will be free to close by the pressure of the spring. Also, the arrangement of the elastic packing, so that it will perform the two duties of packing the valve stem, and constantly pressing the valve towards its seat."

80. For an *Improvement in Torsion Pendulums for Time Pieces;* Aaron D. Crane, Newark, New Jersey.

Claim.—"The method of compensating the torsion pendulum, by so constructing it as that its weights may swing from the centre of their motion in the ratio of the increase of their speed, thus making all its vibrations isochronal."

81. For a *Mode of Arranging and Driving Circular Saws;* Wm. B. Emery, Albany, New York; ante-dated Nov. 13th, 1854.

Claim.—"The manner of arranging a saw mandrel and its attachments, so as to carry

the saw or other cutter through or along the stuff operated upon, while such stuff remains at rest, and the axis of the pulley driving the saw mandrel is caused to vibrate or swing, so as to be always at an equal distance from it, and also from its own driving pulley, for the purpose of preserving the proper tension of the belts. Also, the combination of the three axes with the frame and the guide."

82. For an *Improvement in Ratchet Wrenches;* C. G. Everett, Brooklyn, New York.

Claim.—"The employment of the application to a wrench, of a ratchet of such form and a sliding stop, acting to stop or set free the said ratchet at pleasure, when the wrench is used for tapping."

83. For a *Forcing Pump;* Gilbert G. Farnam, City of New York.

Claim.—"Arranging the two sets of induction and eduction valves of a double acting horizontal pump on two plates, secured one to the top and the other to the bottom of a water box, divided by a vertical partition into two compartments, one end of the horizontal cylinder being secured to one side of the said water box opposite one of the compartments, when this is combined with the connexion of the other compartment of the said water box with the opposite end of the cylinder, by means of a side pipe. Also, making the outer end of the bore of the cylinder of an enlarged diameter, with a ring fitted thereto, having a bore of the same diameter as the cylinder, and flaring or trumpet formed at the outer end, in combination, and as a means of inserting the piston made with conical leather packing rings."

84. For an *Improvement in Entry Lights;* Chas. W. Felt, Salem, Massachusetts.

Claim.—"The combination of the link connexion with the cock for gas, and the sliding tube around the wick tube, for oil or other liquid illuminating material."

85. For an *Improvement in Dredging Machines;* D. S. Howard, Lyonsdale, N. Y.

Claim.—"1st, Constructing the bucket with a truss bar across its bottom, which, in addition to stiffening the bottom of the bucket, serves as a guide to the latch and a fastening to the spring. 2d, Fastening or attaching the latch to the bucket by a lip on the rear end of the latch, entering an aperture of corresponding size in the bottom of the bucket, the latch being held in is place by a spring bearing on it at any point between the lip which forms its hinge or fulcrum, and the catch. 3d, Fastening the buckets to the chain by a bolt passing through the links of the chain between the joints and through the ears and hinges of the doors of the buckets at the upper end, and at the lower end by links or clay cutters, as the case may require, one end of which is fastened to the buckets, one on either side, the other end being secured to the chain by a bolt passing through the links between the joints thereof, whereby the chains are allowed to conform to the curve of the wheel whilst the buckets are suspended between them, without conforming to that curve, and whereby the buckets may be readily disengaged from the chains when out of order, and replaced with others. 4th, The side or clay cutters. 5th, The manner of raising the buckets and chains into their rest position for transportation from place to place, by the combination of the pulley purchase with the wheel and axle, when attached to a car that carries the upper flanch wheels over which the bucket chains work. 6th, The self-acting pawl and catch in combination, by which the pinion is thrown out of gear when the machinery from any cause is turned back. 7th, The manner of feeding by the feeding ways. 8th, The manner of feeding or winding the vessel ahead by an eccentric on the main, or any other revolving shaft operating the levers and pawls, in combination with the windlass; also, the combination of the pawl with the vibrating arms, whether in connexion with the other parts of this feed apparatus or not. 9th, The construction and arrangement of the anchors, in combination with the winding head on the counter shaft, whereby the vessel may be worked ahead, whether the elevating machinery is in operation or not, or during the time that the feeding ways are being drawn back preparatory to taking a fresh cut. 10th, The manner of constructing the cam or chain wheels, the face plates on the periphery of the wheel being of steel, and the cams removable so that they may be turned at pleasure."

86. For an *Improvement in Devices for Stoppers of Bottles;* J. Hanley, City of N. Y.

Claim.—"The making bottles so that the resistance of their contents shall bear laterally upon the cork or stoppler; also, the oblique position of the 'bridge.'"

87. For an *Improvement in Operating Slide Valves in Direct Action Engines;* George W. Hubbard and Wm. E. Conant, Brooklyn, New York.

Claim.—"Connecting the slide valve and its tappet rod in such a way as to allow

either a certain amount of motion independently of the other, and combining them with a steam cylinder, piston, slide valve, and cut-off."

88. For an *Improvement in Hop Extracting Apparatus;* A. Hammer, Philada., Pa.

Claim.—"The retaining vessel, constructed and arranged for the purpose of producing the extract from hops required in brewing malt liquors, using the boiling vessel, or any equivalent device, for the purpose of boiling the hops within the said retaining vessel."

89. For an *Improvement in Mash Machines;* A. Hammer, Philadelphia, Penna.

Claim.—"The application and use of the upper rake, when combined with a mash tun, so as to be rotated in an opposite direction to that of the usual rake thereof, and with a more rapid speed."

90. For a *Rotary Shingle Machine;* J. W. Hatcher, Columbia, Tennessee.

Claim.—"Taking the shingle snugly from an oblong feeder open at the top and bottom, and partially so in front, by cells cut in the wheel. Turning the shingle after one side has been shaved, by means of a cylinder with bars attached, acted upon by a lever and returned to its place by a spring, and throwing the shingle off the wheel by means of a spring lever, after both sides have been shaved. The machine itself, when fed with rifted shingles, shaving both sides and turning out the shingles complete."

91. For an *Improved Arrangement of Slide Valve and Exhaust Passage in Steam Engines;* William C. Hicks, Hartford, Connecticut.

Claim.—"The producing, by one slide valve and valve seat, of two or more exhaust passages from each end of the cylinder, for each induction or steam port."

92. For a *Self-Regulating Wind Mill;* Frank G. Johnson, Brooklyn, New York.

Claim.—"1st, The combining together of the hub or spoke wheel, the regulating wheel, and the break wheel. 2d, The combining together of the weighted levers, the hub or spoke wheel, and the regulating wheel."

93. For an *Improvement in Coke Ovens;* Guillaume Lambert, Mons, Belgium.

Claim.—"The manner of combining the ovens, by means of flues and passages, whereby the smoke and gaseous products generated in each during the earlier stages of the calcining process, is burned in the next, where the process is at a more advanced stage, and the whole of the products of the combustion of the combined ovens are returned under the first, or that in which the process is least advanced, to assist in heating the charge contained therein, and expedite the liberation of the volatile products."

94. For an *Improvement in Refrigerators;* Hugh L. McAvoy, Baltimore, Maryland.

Claim.—"The application of glass to the purpose of lining refrigerators. Also, glass in any form or thickness, enamelled porcelain, or any thing substantially the same."

95. For a *Rotary Planing and Matching Machine;* C. B. Morse, Rhinebeck, N. Y.

Claim.—"The combination and arrangement of the following mechanical elements for the purpose of preparing or reducing and tonguing plank or boards, whether in combination with planing or grooving the same, or not; that is, the adjustable cutter carriage carrying the reducing and tonguing cutters, graduating lever, segmental scale and scales, with the indicating apparatus, or their equivalents."

96. For an *Improvement in Re-working Hard Rubber Compounds;* Charles Morey, Paris, France.

Claim.—"1st, Forming or moulding scrapings, filings, dust, powder, or sheets of hard vulcanized india rubber into a compact solid mass, by means of a high degree of heat and pressure. 2d, The application of dust, powder, filings of hard vulcanized india rubber, for soldering or uniting hard vulcanized india rubber."

97. For a *Machine for Printing from Engraved Plates;* Robert Neale, County of Clermont, Ohio; patented in England, January 18, 1853.

Claim.—"The combined apparatus for inking, wiping, and polishing engraved plates used in copper and other plate printing, the same consisting, 1st, In the attachment of the engraved plate to an endless chain with which it revolves while undergoing the several processes of inking, wiping, polishing, and printing. 2d, In the bed plate with its movable plate holder, and its strips or bearers, as constructed. 3d, In the mode of

inking the plate so as to confine the ink to the engraved portion. 4th, In the mode of regulating the pressure of the wiping belt upon the plate. 5th, In the mode of keeping the polishers clean by an endless belt of cotton, or other proper cloth, itself kept in proper order by the application of whiting, or other suitable drying powder, and preserved from dust and grit by the action of the revolving brush."

98. For an *Improvement in Windlasses;* Olden Nichols, Lowell, Massachusetts.

Claim.—"1st, The cylinder. 2d, The action and co-operation of one or more pawls with the cylinder, so arranged with this cylinder as to come in contact with and firmly hold the chain when passing either way over the top of this cylinder, which constitutes with the pawls, both the windlass and stopper. 3d, The combination of the cylinder pawls and the adjustable guides, all or either of them, for raising, stopping, and fleeting chain cables."

99. For an *Improvement in Grain Harvesters;* J. E. Newcomb, Whitehall, N. York.

Claim.—"Making the hinged apron extensible; I claim the mode of keeping the scythe plate to the shear edges of the guides, said mode consisting in the employment of the grooved pressure plate or bar, and set screws."

100. For an *Improvement in Oscillating Engines;* John A. Reed, City of New York.

Claim.—"The arranging and placing the valves and steam ports on each side of the cylinder, and in combination therewith, so as to let the steam in on both sides of the cylinder at the same time at opposite points, so as that the steam from opposite points may meet in the cylinder, and so balance the pressure as to prevent that severe friction which is occasioned by letting the steam in on one side only of the cylinder at a time. Also, the trunnion bearing, made adjustable to the trunion by the set screws, and so arranged that the conical trunnions may be accurately adapted to the conical seat."

101. For an *Improvement in Machines for Kneading Dough;* John Louis Rolland, Paris, France; patented in France, April 11th, 1851.

Claim.—"The use of open frames for kneading dough, composed alternately of long and short blades, projecting inwardly from the cross bars."

102. For an *Improved Carriage Cramp;* Samuel P. Sanford, Fall River, Mass.

Claim.—"Constructing the cramp with anti-friction rollers, said rollers being provided with flanches, and having such a position that the peripheries of the tires and the sides of the felloes of the front wheel will, when the front wheels are cramped, bear against the rollers."

103. For an *Improved Apparatus for Soldering Tin Cans;* William J. Stevenson, City of New York.

Claim.—"1st, The manner of constructing the upper extremities of the jaws of the clamp, for the purpose of forming a groove or channel to receive a strip of solder, and confine it where its presence is required after being melted. 2d, The manner of interposing a strip of wood between the cold iron of the mandrel and the lap, forming the joint or seam of the can, for the purpose of preventing the solder being cooled too rapidly after it has been melted."

104. For an *Improvement in Life-Preserving Seats;* N. Thompson, Williamsburgh, N.Y.

Claim.—"The adapting or accommodating life preserving seat, whose components are a separated buoyant seat, a hinge, and a spring, combined with each other."

105. For a *Stave Jointer;* James W. Treadway, Crown Point, New York.

Claim.—"The curved bed plate upon which the stave is bent and held by clamps, when in combination with suitable devices, to allow it to rotate partially about a fixed axis, for the purpose of giving any degree of bevel to the joints, and for jointing both sides of the stave without its change of position on the bed plate."

106. For an *Improved Beef Spreader;* Frederick Tesh, Johnstown, Pennsylvania.

Claim.—"The construction of a spreader for beef of a stick and tongue, operated by a cog wheel and ratchet work."

107. For an *Improvement in Flouring Mills;* John L. Yule, New Orleans, La.

Claim.—"Adjusting the parallelism of the upper stone to the lower, by means of the swinging frame and pivots, the height of the lower stone being regulated by the step and

screws acting on the spindle, the said spindle having a boy to give the shake motion to the shoe by means of the arm and rod."

108. For a *Lathe for Turning Fancy Handles, &c.;* L. Wentworth, Burlington, Iowa.

Claim.—"1st, The mode of arranging and operating the cutters; that is to say, attaching them to arms which revolve with the mandrel, and are attached to collars which are allowed to slide upon the mandrel, but not permitted to run with it, and so guiding the said arms by the inclined slots and studs, or their equivalents, that the sliding movement of the collars upon the mandrel produced by cams or pattern wheels, will move the cutters to and from the centre of the work, for the purpose of turning mouldings or grooves at intervals, or giving an irregular profile to the article being turned. A saw, arranged as described, upon the lathe in a swinging gate, which is weighted opposite the saw, to throw the saw to an inoperative position, but which is tilted to throw the saw into operation at the proper time to cut off the finished articles from the stick, by means of a lever actuated by a wiper on a wheel, which is attached to one of the feed rolls, or otherwise so driven as to make one revolution while the stick moves the length of one of the articles to be turned."

109. For an *Improvement in Looms;* Joseph Welsh, Philadelphia, Pennsylvania.

Claim.—"In combination with the lay, the lever and cam, when arranged so that in every change of the shuttle-box the picker shall be released from contact with the shuttle by a positive motion."

110. For an *Improvement in Processes for Making Japanned Leather;* Hiram L. Hall, Beverly, Assignor to James C. Stimpson, Salem, Massachusetts.

Claim.—"The improvement in the process of manufacturing patent or japanned leather, which consists in applying to the leather the composition herein described, (prepared either with or without borax,) and then submitting it, with the varnish coatings thereon, to a high degree of heat, whereby the surface of the leather is so matured as not to be affected by any temperature or change of climate."

111. For an *Improvement in Machines for Forming Kettles from Metal Disks;* Lyman C. Camp, Berlin, Connecticut, Assignor to Phelps, Dodge & Co., City of N. Y.

Claim.—"The employment of a pair of rollers, in combination with a pair of clamps, or their equivalents, all arranged for the purpose of operating upon a disk of brass or other metal, to roll out the said disk from a certain distance all round its centre to its edges, and bend or draw the part so rolled to form an angle with the central part, and cause it to be distended radially or towards the edges, and to be contracted circumferentially, thereby forming the said disk by successive stages into a kettle or vessel, or other similar article, with conical or cylindrical sides, without employing a mould or form."

112. For an *Improvement in Manufacturing Metal Tubes;* Wm. Beasley, Smethwick, Assignor to self, J. and J. W. Brett, Westminster, and C. W. Tupper, London, England.

Claim.—"The forming of a metallic tube by winding a strip of metal spirally on a mandrel, and welding it by cross rolling."

113. For an *Improvement in Looms;* William Tongue, Philadelphia, Assignor to self and James Buckley, Ladsburyville, Pennsylvania.

Claim.—"The combination of the continuous cord with the pulleys and double pulleys, irrespective of the number of double pulleys, or pulleys, B, as these are intended to be increased or diminished, as the number of shreds wanted may require."

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114. For an *Improvement in Fire Arms;* Thomas H. Barlow, Lexington, Kentucky.

Claim.—"Constructing the chamber of the cannon nearly square, and winding, so as to give the projectile the motion and accuracy of the rifle ball."

115. For an *Improvement in Seed Planters;* Jarvis Case, Springfield, Ohio.

Claim.—"1st, The agitation of the seed slide, by means of a rocker, wire, and levers, for the purpose of filling the seed hole with an uniform amount of seed. 2d, The elastic cut-off plate, in combination with the brush."

116. For a *Water Metre;* John S. Barden, New Haven, Connecticut.

Claim.—"The two heads, being secured one to each end of the cylinder, by means of bolts in the form of , for the purpose of collecting all sediment that may be drawn into the cylinder through the passages, and is not thrown out, or the collection of sediment upon their sides deposited from the water itself, without which the machine would, in a short time, cease to operate. 2d, The two small pistons with the spiral springs attached, in combination with the guides and , the latches suspended from above by the hinged joints and the bumper attached, the latches falling of their own gravity. 3d, The construction of the valve suspended upon the two arms, in connexion with the hanger, the two boxes, the two spiral springs within the same, and resting upon the top of the said boxes, with the cross bar and screws for regulating the pressure of the valve; also, in having the cross bar and elliptic spring resting on the boxes themselves; and, finally, the entire combination of the above parts."

117. For an *Improvement in Sewing Machines;* Jotham F. Conant, City of N. York.

Claim.—"An endless rotary cloth feeder, in combination with a reciprocating needle or needles."

118. For a *Bench Plane;* William C. Hopper, Pittsburgh, Pennsylvania.

Claim.—"The constructing of planes with the chisel or bit set in front of its wedge, in combination with the use of a mouth-piece."

119. For an *Improvement in Fire Arms;* Edmund H. Graham, Biddeford, Maine.

Claim.—"So attaching the tubes or short barrels in which the charges are placed, to a revolving plate, as to admit of their being separately and successively elevated into a horizontal position, in a line with and so as to form a continuation of the gun barrel, while the others retain a vertical position. Also, the lever, arranged for elevating and lowering the tubes which hold the charges, and for cocking the gun."

120. For an *Improvement in Temples for Looms;* John H. Allen, Biddeford, Maine.

Claim.—"Arranging the turning joint of the temple about midway between the end of the shat of the inner jaw, in combination with applying the spring so that it shall rest at or near its middle against the adjusting screw, and at its end against the two arms from the said shaft, the same enabling me not only to nearly, if not entirely, balance the temple, and prevent it from undue pressure upon the cloth, but to obtain from the spring a double action on the shaft, or an action on each side of the turning joint, by which the advantages in operating the temple and preserving it in correct operation are attained."

121. For an *Improved Gold Washer and Amalgamator;* J. S. Addison, City of N. Y.

Claim.—"Placing a trunk above a box which forms a receptacle for the gold or other metal separated in the trunk, and which contains a proper quantity of quicksilver for amalgamating the said gold or metal, and also a water wheel which is driven by the entrance into the said box of the water which is to form the upward current in the trunk, for the purpose of giving motion to a scraper to agitate the quicksilver to promote amalgamation. 2d, The arrangement around the trunk into which the pulverized ore, quartz, &c., is fed, to meet an ascending current of water which flows through and over the trunk, of one or more troughs to contain quicksilver, and a corresponding number of overhanging rims situated above them, that the flow of water, ore, &c., over one rim falls into the middle of the quicksilver unto the trough below it, and keeps the same properly agitated to amalgamate with it the whole or some portion of the gold or metal contained in the overflow."

122. For an *Improvement in Plugs for Lubricating Axles;* Alfred C. Garratt, Hanover, Massachusetts.

Claim.—"The chambered screw plug, open at its lower end, and having a passage made through its side, and applied for removing the accumulated wheel grease."

123. For an *Improvement in Lamp Shades;* M. B. Dyott, Philadelphia, Penna.

Claim.—"The arrangement of the shade, shield, and wires, or their equivalents, with the intervening space for the protection of the shade."

124. For an *Improvement in Door Latch Locks;* John C. Kline, Pittsburgh, Penna.

Claim.—"The arrangement, in double key-holed right and left hand locks, of the

key tumbler with its noses or projections, in relation to the spring receiver and the shoulders of the bolt."

125. For an *Improvement in Ploughs;* Arnton Smith, Scottville, Illinois.

Claim.—"The manner of coupling plough 1 with plough 2, by means of hinged slide rods, bar, and rod, for the purpose of allowing each plough a somewhat free and independent motion, and yet bring the ploughs under the control of one hand of the ploughman, and in some degree control both ploughs."

126. For an *Improvement in Lime Kilns;* Samuel H. Robinson, Baltimore, Maryland.

Claim.—"The so arranging of a series of side kilns around a central kiln as that the waste heat from the former may be used for burning the limestone in the latter, whereby a great saving of fuel and labor is attained, a more regular disposition of the heat made available, and either of the surrounding kilns stopped off, cooled, and drawn, without interfering in the least with the others of the series."

127. For a *Moulding Machine;* George M. Ramsey, City of New York.

Claim.—"The automatic reversible feed, or its equivalent, whereby the two opposite sides of the same piece of stuff are worked by the double action of one cutter head by once passing the stuff to and through the machine. Also, the arrangement of the cone and fan."

128. For an *Improvement in Fire Arms;* Alonzo D. Perry, Newark, New Jersey.

Claim.—"The arrangement of the tube in the stock for containing the caps, and a spring to force them forward in a line radiating from the axis of motion of the turning breech, and placing the nipple also in a line radiating from the axis of motion of the breech, so that when the breech is opened to receive a charge, the nipple will be brought into the same radial line with the cap tube, so that the same spring which forces the caps forward in the tube may also force one of them upon the nipple, thus simplifying the mechanism for automatic capping. Also, the use of an eccentric, or its equivalent, in combination with the capping tube and nipple on the movable breech, for the purpose of forcing the caps to their proper place on the nipple as the breech is brought in line for the discharge. Also, pivoting the trigger to the lever for operating the breech, so that the trigger shall be carried in and out by said lever, and shall not be brought into a position to act upon the lock until the breech is in a line with the barrel."

129. For an *Improvement in Constructing Brake Blocks for Railroad Cars;* Lucius Paige, Cavendish, Vermont.

Claim.—"The shoe, and the socket or bearing thereof, and applying them, that the shoe may extend entirely through and out of the socket in opposite directions, and be capable of being moved up to the wheel as fast as occasion may require, until it, the shoe or rubber, is worn up or rendered unfit for further service."

130. For an *Improvement in Scales;* John L. McPherson, New Vienna, Ohio.

Claim.—"The concentric loaded rims, in combination with the attachment of the dish."

131. For an *Improvement in Sewing Machines;* H. B. Smith, Lowell, Mass.

Claim.—"A slit or fissure formed in a needle, so as to be opened by any proper pointed instrument, and the thread inserted in this fissure, and then moved near to one end of it, thereby removing the pointed instrument, the two elastic or spring sides of this fissure close together and pinch and hold the thread, so that the needle can be operated to sew a curved or straight seam, and a through and through or back stitch. 2d, The finger, so arranged and operated (on the arm, by means of the spiral spring, the ring to adjust this spring, and the stock, or otherwise,) as to draw the thread through the cloth, so as to draw up the stitch, and then let go of the thread by the revolving or moving of this finger, and the arm, or its equivalent."

132. For a *Moulding Machine;* C. B. Morse, Rhinebeck, New York.

Claim.—"Constructing the cutter heads of two flanched disks, with slots or openings through one of the disks, to admit of cutters being attached to the other part, and partially masked by the flanch of the perforated disk, in combination with cutters, in openings through the rims or flanches, and secured respectively to each disk, so as to present a cutting edge over the whole space caused by the opening or closing of said disks by

means of nuts and set screws, said combination favoring a current inward from the edges of the cutters to fill the partial vacuum formed in the interior of the head by the rotation of the same, thereby causing a speedy inward removal of the shavings from the cutters, and admitting of the double action of the same. Also, the adjustable shields, in combination with the feed rollers, for preventing the said rollers from lifting the piece operated upon against the cutters when the feed is not continuous, and the extremity of the piece reaches the roller."

133. For an *Improvement in Spring Balances;* E. P. Beckwith, New London, Conn.

Claim.—"The employment or use of the cylinder surrounding the spring balance, and divided into parts or graduated so that by the aid of the index rod, or its equivalent, not only the weight, but also the whole or aggregate cost of any article may be determined at a given price per pound."

134. For an *Improved Steering Apparatus;* Abijah R. Tewksbury, Boston, Mass.

Claim.—"Arranging the rudder head within a concentric or surrounding frame or case fastened to the deck, and applying on the top of the rudder head, and within the case, a driving shaft gearing, and one or more curved racks of internal cogs, the whole to be operated by a hand applied to turn the shaft, the said arrangement of parts rendering their combination not only exceedingly efficient and compact as a steering apparatus, but one wherein the lifting or raising of the rudder by a wave or sea is not liable to injuriously derange the machinery."

135. For *Improved Hand Truck;* Parley Hutchings, Norwich, Massachusetts.

Claim.—"The elevator, constructed and combined with a hand truck, whether operated by a windlass or any other device commonly employed for raising weights."

136. For an *Improvement in Grain and Grass Harvesters;* O. B. Judd, Little Falls, New York.

Claim.—"1st, The employment or use of the rotating cutters and stationary cutter. 2d, Attaching the connecting rod to the outer end of the sickle, for the purpose of being enabled to employ a long straight rod with a compact machine. 3d, Attaching the sickle bar to the finger bar by hinges, whereby the sickle and connecting rod are kept properly in place, and the sickle readily attached and detached from the machine."

137. For an *Improvement in Straw Cutters;* John A. Pitts, Buffalo, New York.

Claim.—"So combining the cutting wheel and bar as that the edges of the cutters must always pass the bar at a fixed adjustable distance, whether the tendency to force the cutters from the straw be great or not."

138. For a *Machine for Making Boxes of Paper;* R. L. Hawes, Worcester, Mass.

Claim.—"1st, The pasting apparatus, consisting of rollers working in the open bottoms of vessels containing paste, or other adhesive material, said rollers having cavities or cells to receive paste from the paste vessels, and transmitted to such parts of the roll or piece of paper, or other material, as may be necessary, as the paper passes between them before entering the machine. 2d, The employment of a series, consisting of any suitable number of moulds of proper form for the boxes, arranged so as to work radially, or nearly so, upon or within a revolving mould wheel outside a series of tables, in such a way that a piece of paper, or other thin material to form a box, is taken between each of the several moulds and their respective tables, and drawn between the edge of a projection and of a clamp, or edges attached to or forming part of the wheel, for the purpose of bending the paper up the sides of the mould, and thus forming three sides of the box. 3d, Attaching to the mould wheel between the moulds, a number of blades corresponding with the number of moulds, so arranged at equal distances apart and at equal distances from the axis of the wheel, that the distance between their cutting edges shall be equal to the required length of the paper to form the box, and that they are severally and successively caused, by the revolution of the mould wheel, to act in combination with a fixed knife suitably arranged in any way, and cut the paper or material from the roll in proper lengths to form the boxes. 4th, The clamps, arranged one at the side of each mould, and actuated and operating for the purpose of lapping the part of the paper or material over the mould, to form part of the fourth side of the box. 5th, The presser, arranged relatively to the mould wheel, and operating for laying down the edge of the part 37 of the paper or material, and confining it till the part 38 is lapped over it. 6th, The presser, arranged relatively to the mould wheel, and

operating to lap the part 38 of the paper or material over the part 37, to complete the fourth side of the box, and at the same time lap the part 40 over the end of the mould, to commence the end of the box. 7th, The levers, working as described, on or within a wheel, or its equivalent, which rotates with the mould wheel, and successively so operated, by coming in contact with a fixed tongue, or other fixed part of the machine during the revolution, that each at the proper time folds the part 41 of the paper or material, and laps it over one side of the part 40. 8th, The arm carrying the plate, by coming in contact with which, the part 42 of the paper or material is folded and lapped over the opposite side of the part 40, to that covered by the part 41, also carrying the plate 14, which is caused by the action of the studs on the wheel, or its equivalent, to be moved from the central shaft to lap the part 43 over the parts 40, 41, 42, and thus complete the formation of the bottom of the box. 9th, The stationary smoothing and pressing plate, to smooth and finish the bottom of the box by the revolution of the latter in contact with it. 10th, The arrangement and mode of operating the roller 44, to take the glue or adhesive material from a fixed trough, and distribute it over the bottom of the box, to prepare the same for sanding. 11th, The shears at the end of the table 61, along which the printed string of labels passes from the printing apparatus, in combination with the intermittent motion of the said printing apparatus, for the purpose of moving forward the labels at proper intervals, and cutting them off one by one, as required, to be presented to the boxes. 12th, The table, 71, attached to or supported above the sheer blade, so as to move with it for the purpose of receiving the cut label and applying it to the box. 13th, The arrangement and mode of operating the tongs, the said tongs being arranged so that each box will pass them after being completely formed, and being operated to move towards the mould wheel with open jaws, and to close upon the box when it is between them, so that the mould, by a movement in the direction of its length, may be withdrawn from the box, and then to move with closed jaws from the mould wheel, to carry the box to a trough or box of sand. 14th, The hook attached to one jaw of the nippers, and operated upon so that as the said jaws descend with the box towards the sand box, it throws up the mouth of the box to bring it to a nearly upright position, to dip the bottom in the sand. 15th, The rod to knock over the finished box from the sand box. 16th, The general arrangement and combination of the several portions of the machine, either with or without the labeling and sanding apparatuses, and their appendages."

139. For an *Improvement in Seed Planters;* Elijah Morgan, Morgantown, Virginia.

Claim.—"1st, The combination of the stationary protecting bar and the reciprocating feed bar, when the latter operates within a groove in the former. 2d, The combination of the V shaped forms of the bottom of the hopper and the bottom of the reciprocating bar, when said bar is provided with openings from both sides, which meet and vibrate over the holes in the bottom of the hopper."

140. For a *Stereoscopic Medallion;* John F. Mascher, Philadelphia, Pennsylvania.

Claim.—"Constructing a medallion or locket with two supplementary lids, containing each a lens, and arranged so as to fold within the picture lids, and in such relation to the same that upon being opened and properly adjusted, they shall cause the lenses to stand opposite said lids, and thereby convert the medallion into a stereoscope, said arrangement also rendering the medallion useful as a microscope and sun glass."

141. For an *Improvement in Moulds for Casting Projectiles;* Hezekiah Conant, Hartford, Connecticut.

Claim.—"The arrangement of moulds in the periphery of a wheel, combined with a stationary band, which also forms part of each mould."

142. For a *Lubricator for Steam Engines;* John Sutton, City of New York.

Claim.—"Arranging the passage or passages between the grease reservoir and forcing cylinder, so as to be opened and closed by the movement of a solid piston, thereby dispensing with a valve, or equivalent, either in the piston or in the said passages, and only requiring one valve or cock in the discharge passage."

143. For an *Improvement in Seed Planters;* Stephen L. Stockstill and P. H. Humes, Brandt, Ohio.

Claim.—"1st, The converging openings of the gauge board, enabling the graduation of the amount of feed without narrowing or circumscribing the passage with respect to

the size of grain, which is thus preserved from cutting or injury. 2d, The dividing ridge or flanch around the perimeter of the feed wheel at its mid-width, enabling the same wheel to 'score' two exactly equal rows, and at the same time serving to stir the grain, and to shift out of the way any tailings or other obstructions that would intercept the discharge. 3d, The beveled or flaring axial mortise through the feed wheel, preventing any unevenness of the axle from wabbling or clogging the wheel, or disturbing the feed."

144. For an *Improved Arrangement of Filtering Apparatus to Prevent Incrustation in Steam Boilers;* Gustavus Weissenborn, City of New York.

Claim.—"The arrangement of the exhaust chamber, girdled at its lower part by the cold water, with the basin, chamber, and filters."

145. For *Improved Dies for Making Bolts;* J. T. Willinarth, Northbridge, Mass.

Claim.—"The dies, constructed for the purpose of operating simultaneously upon both sides of the head."

146. For an *Improvement in the Mode of Connecting Pipes for Steam Brakes;* W. Wright, City of New York.

Claim.—"Providing each end of the several lengths of pipe for conveying the steam or compressed air under the cars with a valve, and an elastic or movable tongue applied so as to allow the valve to be closed by the pressure of the steam or air when the end of the pipe is disconnected, but to be caused to open the valve by the entrance of the end of the pipe into the mouth-piece of the connecting tube."

147. For an *Improved Building Block;* Elizabeth A. Messinger, Adm'rx., and Wm. Spencer, Adm'r., of the Estate of John A. Messinger, dec'd., Milwaukie, Assignors to Ambrose Foster, Portland, Wisconsin.

Claim.—"The building block herein described, the same composed of sand and lime, in the proportion of 12 parts of sand to 1 of lime, mixed together and pressed in moulds."

148. For *Improvements in Door Knobs;* William Leighton, Assignor to New England Glass Company, Cambridge, Massachusetts.

Claim.—"The hollow silvered knob, sealed up and protected."

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149. For an *Improvement in Hernial Trusses;* Wm. M. Bonwill, Camden, Delaware.

Claim.—"The combination of the peculiarly formed hoop with the umbilical pad and strap, for the purpose of preventing the movements of the body from displacing the pad in either umbilical or in inguinal hernia."

150. For an *Improved Gas Heater;* William F. Shaw, Boston, Massachusetts.

Claim.—"The arrangement and combination of the air pipe, the perforated distributor, the air chamber, the flue pipe, and its surrounding chamber of combustion, or reverberatory dome, provided with an outlet pipe at or near its lower end, the said reverberatory dome or chamber being made to operate in connexion with both the internal and external air ducts, and for burning the surplus volatile products."

151. For an *Improvement in Rollers for Corrugating Sheet Metal;* Solomon G. Booth, City of New York.

Claim.—"Making the swages and dies for forming beams of wrought iron of numerous thin sections, so that one, two, or more sections can be removed to produce beams of different forms, for the purpose of saving the expense and inconvenience of a multiplicity of pairs of swages and dies."

152. For a *Hay Making Machine;* George A. Brown, Middletown, Rhode Island.

Claim.—"The construction of a machine, in manner and form as described, applying the power directly from the driving wheels to the spreading apparatus, thus saving the loss of power caused by friction in a series of wheels, using coiled or spring teeth, and the application of such machine to the purpose of spreading and turning hay."

153. For an *Improved Instrument for Cutting out Stone;* H. J. Brunner, Nazareth, Pa.

Claim.—"Cutting out slate or other stone from quarries, by means of a cutter stock provided with cutters, and having a reciprocating motion given it by means of a toothed

wheel, in which pinions are made to gear alternately, in consequence of the arrangement of the teeth on the periphery of said wheel, said cutters having the proper feed motion given them by the pawls, ratchets, pinions, and racks, or other substantially equivalent device."

154. For an *Improvement in Rollers for Curtains;* Dexter H. Chamberlain and John Hartshorn, Boston, Massachusetts.

Claim.—"The manner of applying the spring to the curtain roller; that is, extending it axially entirely through the roller and its two journals, and affixing it to the roller and both its brackets, (or journals extended from and fastened to them,) such not only affording advantages which a long spring has over a short one, but also important facilities in applying the spring, or modifying its tension, as occasion may require."

155. For an *Improvement in Carriages;* Geo. R. Comstock, Manheim, New York.

Claim.—"The employment of fills, in combination with a pole, which pole has attached to it an elliptic spring capable of a motion around the pole, to which spring, as well as to the fills, the draft animals are to be attached by the harness. Also, the arrangement of the fills, by which the space between them can be enlarged or contracted, to adapt it to one or two horses, as may be required, the same to be effected by a right angled elbow on the rear end of each fill, having several bolt holes through which it can be bolted to the frame work of the carriage, the fill turning as on a pivot, in a loop attached to the outward extremity of the said frame work. Also, the combination of the united fills, pole, and elliptic spring, with a carriage."

156. For an *Improvement in Carriage Seats;* G. R. Comstock, Manheim, N. York.

Claim.—"I claim the method of adjusting the load carried in two wheeled vehicles, so as to keep the pressure upon the animal drawing the same equal or nearly so, whether the carriage be moving upon level or uneven ground, by shifting the seat or upper body backward or forward, using an axis with toothed quadrants operating upon toothed racks attached underneath said seat or body, (or by the use of any mechanical equivalent,) said axis being manœuvred by a lever which passes through the arm of the seat or upper body, the said mechanical apparatus being in combination with the carriage body and seat."

157. For an *Improvement in Looms;* James Eccles, Philadelphia, Pennsylvania.

Claim.—"Moving and holding the picker forward in movable shuttle boxes, for the purpose of stopping the shuttle thereby, and causing the picker, after having stopped the shuttle, to recede by the action of the lever and pin, or their equivalents."

158. For an *Improvement in Means for Holding Window Blinds;* Henry A. Frost, Worcester, Massachusetts.

Claim.—"The application to window blinds of a semi-circular spring rod, which may bear upon a wide staple beneath the blind, which acts upon it at all times, so that the blind may be retained in any desirable position."

159. For an *Improved Marquetry;* Louis Francis Groebl, Philadelphia, Penna.

Claim.—"The marquetry, in which the different pieces of which it is composed are firmly united at their adjoining edges."

160. For an *Improved Hot Air Furnace;* Michael Greenebaum, Chicago, Illinois.

Claim.—"The arrangements of the cylinder in the drum, in combination with the perforated partition and the pipes and valve, for the purpose of regulating and equalizing the radiation of heat of hot air furnaces."

161. For an *Improved Mill for Cutting and Grinding Vegetables;* William H. Harn, Carlisle, Pennsylvania.

Claim.—"A slicing or cutting apparatus, consisting of a cylinder armed with knives, and working in connexion with stationary knives, in combination with a crushing or grinding apparatus, the whole being so constructed as to slice the fruit or vegetables, and then crush or grind them in the same machine."

162. For a *Book Brace;* William Ives, Buffalo, New York.

Claim.—"The combining with the brace the pointed spring bolt and spurs. Also, the application of the adjustable slide or brace."

163. For an *Improvement in Lifting Jacks;* Samuel G. Jones, Fitzwater Town, Pa.

Claim.—"The peculiar manner in which I combine the main post, the sliding piece, and the bent lever, the fulcrum of the said lever being placed near the lower end of the main post, and its weight point adjustably connected with the sliding piece by means of the holes near the lower end of the said sliding piece, whilst the upper end of the same piece is adapted to slide within the loop formed on the upper end of the main post."

164. For an *Improvement in Rolling Iron Shutters;* Charles Mettam, City of N. Y.

Claim.—"Making the slats with an exterior protruding arch at their centre, combined with flat laps or bearings at their edges, the slats being arranged in relation to each other, and united together, as set forth, by which configuration the shutter may be rolled up in a less compass, the labor of rolling up reduced, and many other advantages obtained."

165. For an *Improvement in Metal Folding Machines;* D. Newton, Southington, Conn.

Claim.—"The application to folders (for sheet iron, tin, copper, &c.,) of three or more pairs of steel fingers, all of the same shape, one-half of which are fastened to the plate which turns the fold, and the other half secured in a hollow underneath the same, the whole acting together, thereby drawing and holding the plate firmly on the metal whilst the fold is turning. Also, the gauge attached to the plate, by which the width of the fold is regulated."

166. For an *Improvement in Machines for Washing Paper Stock;* H. W. Peaslee, Malden Bridge, New York; patented in England, Sep. 20, 1854.

Claim.—"The arrangement of the oblique curbs, in continuous succession, round the open discharge end of the revolving screen cylinder, and forming channels between them to conduct the stock continuously, as the cylinder rotates, beyond the discharge edge of the cylinder, when combined to operate together with elevating hooks within the cylinder, and serving to retain a copious supply of water in the cylinder, for the proper washing of the stock, and to check the run of the stock through the cylinder to a speed in accordance with the conveying action of the cylinder, or its elevating hooks, to insure the full and regular action of the hooks on the stock."

167. For an *Improvement in Fire Engines;* Albert W. Roberts, Hartford, Connecticut.

Claim.—"The arrangement of the valves of pumps for fire engines and other purposes. Also, the arrangement of the compound brake and levers."

168. For an *Improved Compound Rifling Machine;* E. K. Root, Hartford, Conn.

Claim.—"The method of giving the motion to the cutter stocks for giving the increasing twist, by means of the connecting rod, or its equivalent, turning on a fixed centre, and describing a circle at the point of its connexion with the cutter carriage, which moves in a tangent line. Also, combining a series of cutter spindles with the said connecting rod, or its equivalent, by means of a sliding rack connected with the said rod, and engaging pinions on the said spindle. Also, in combination with the mandrels that carry the barrels, the slide, and its appendages, to act upon and turn the mandrels, in combination with the dogs for locking and holding the barrels during the rifling operation, the said dogs being operated by the said slide. Also, the mode of operating the series of stops to insure an accurate adjustment of the series of cutters. And, finally, the adjustable crank pins for operating the cutter carriage, in combination with the mode of forming the connexion of the connecting rods with the carriage, by means of slides governed by adjusting geared screws, as a means of adapting the machine to the rifling of barrels of various lengths without the necessity of changing the relations of the mandrels and the stops for setting the cutters."

169. For an *Improved Apparatus for Supplying Furnaces with Pulverized Metal,* Eloy Schmitz, City of New York.

Claim.—"Arranging within the blast pipe of a furnace, or other fire place, another and smaller pipe or tube governed by valves, to admit and cut off the blast, when this is combined with the charging tube, also governed by a valve, so that when the blast is forcing the pulverized substance from the tube within the blast pipe, the blast shall be cut off from the charging tube, and when the charging tube is open for the liberation of

the charge, the blast shall be cut off by the valves below. Also, in combination with the above charging and discharging tubes governed by valves, the employment of a branch tube governed by a valve opening to the atmosphere, to prevent the pulverized substance from being held in the charging tube by any excess of pressure which may be due to the entrance of the blast during the time the valves of the discharging tube are opened. Also, in combination with the discharging and charging tubes, the employment of the conductor and the punch rod."

170. For an *Improvement in Feeding Mortising Machines;* R. P. Benton, Rochester, N.Y.

Claim.—"Feeding the stuff to be mortised to the cutter, by means of a rotating screw rod operating upon a slide, and an adjustable crank which gives a reciprocating motion to the slide, the above parts operating conjointly."

171. For an *Improved Compound Crowbar;* Isaac J. Cole, Piermont, New York.

Claim.—"The combination of two levers (one of them having a circular projection on its lower side,) with the head block."

172. For an *Improvement in Fastening Centre Bits;* Abel W. Streeter, Shelburne Falls, Massachusetts.

Claim.—"The stationary catch, in connexion with the cam or bearer."

173. For a *Lubricator for Steam Machinery;* John Sutton, City of New York.

Claim.—"1st, Arranging the cylinder and piston of the feeder within or in the bottom of the grease reservoir, with the cylinder opening directly into the reservoir, whereby the construction of the feeder is simplified, and it is rendered more compact, and provision is made for collecting the sediment within the reservoir. 2d, Constructing the feeder with a valve in the piston opening towards the discharge end of the cylinder, and a valve in the discharge end of the cylinder opening against and closing with the pressure of the steam or motive agent, whereby it is caused to be only necessary to move the piston once back and forth to charge and discharge the feeding cylinder, and the lubrication is effected more quickly, and with less trouble to the engineer."

174. For an *Improvement in Lanterns;* Lewis Hover, Jersey City, New Jersey.

Claim.—"The arrangement of the springs, hooks, and ledges, operated as a fastening to secure the base of the lantern to the other portion of the same."

175. For an *Improvement in Iron Window Blinds;* Henry Blakely, City of N. York.

Claim.—"The method of fastening the metal blinds or slats to the frame, by securing their ends, or the pivots on which they turn in the eyes, in such manner as will prevent the blinds from being taken out by any force applied to bend them, short of the breaking strength of the several parts."

176. For an *Improvement in Looms;* George Copeland, Lewistown, Maine.

Claim.—"1st, Placing the cams which operate the two sets of harness upon two shafts carried by opposite arms of lever beams, which are capable of rocking upon a fixed shaft, with which the cam shafts are geared, and from which they receive the motion relatively to each other, to change the operation of the harness. 2d, The method of securing the lever beams, to maintain the proper position of the cam shafts for one mode of operating the harness and changing their position for the other mode of operating, by means of a spring or springs, or equivalents, or hook and a disk, or equivalent, carrying a stud. 3d, Weaving the closed part of the fabric or bottom of the bag, giving the lever beams a continual rocking movement on the shaft, for the purpose of enabling them to be caught by the hook and secured in position for weaving the open part of the fabric, as soon as a sufficient length of closed part or bottom has been woven, and the hook escapes from the stud which holds it during the latter weaving operation. 4th, For the purpose of throwing and catching the two shuttles simultaneously, pivoting the shuttle boxes to the ends of the lay, so that they may, by a vibrating or swinging motion, move opposite to the upper or lower race-way, as required. 5th, The manner of operating the two shuttle boxes, so that both may move simultaneously to and from the position for throwing and catching the shuttles, by connecting both with a lever, which is arranged to work under the lay, and receives the required motion from a treadle and cam, or other analogous means. 6th, The slots in the bars which form the upper race-way, for the purpose of

enabling the weft thread, which is being carried through the warp, to draw directly or nearly so from the filling point of the cloth or fabric."

177. For an *Improvement in Cotton Seed Planters;* Isaac Williams and Isaac W. Bausman, Alleghany County, Pennsylvania.

Claim.—"The use and combination of two cylinders, placed one above the other, not in the hopper, but in the throat below the hopper, one furnished with a row of long teeth, and the other with a row of short teeth, the teeth on each cylinder being placed helically around it, for the purpose of separating and distributing or scattering the cotton seeds."

178. For an *Improvement in Repeating Cannon;* Samuel Huffman, Charlestown, Ill., Assignor to self and Dennis O. Hare, Washington, D. C.

Claim.—"1st, The movable forward section with its flanch, in combination with the revolving rear sections secured to the plate. 2d, The flanch, in combination with the projection on the plate. 3d, The jacket or cold water tank. 4th, The vent closer."

179. For an *Improvement in Buckets for Chain Pumps;* E. Morris, Burlington, N. J.

Claim.—"The combination and arrangement of the gum ring with the cone."

180. For a *Match Machine;* Leopold and Jos. Thomas, Alleghany City, Penna.

Claim.—"1st, The use of the sliding carriage with the feed rollers. 2d, The combination of sliding self-shoving head, levers, and plungers, for the purpose of packing the finished matches in boxes. 3d, The carrier wheel and roller for applying the phosphoric composition to the matches by machinery."

181. For an *Improvement in Paddle Wheels;* J. U. Wallis, Danville, New York.

Claim.—"1st, The attachment of the oblique paddle floats, each by one edge only, to opposite sides of a wheel, or its equivalent. 2d, Attaching the paddle floats to the wheel by hinge joints, for the purpose of enabling them to be adjusted at various degrees of obliquity by screws, and to adapt their position to the direction of the revolution of the wheel."

182. For an *Improvement in Oscillating Engines;* G. F. Wood, Ulysses, N. York.

Claim.—"The arrangement of the separate induction and eduction valves communicating with separate induction and eduction ports and passages through the two trunnions, and connected with the same lever, to move simultaneously, and the same distance for stopping or reversing the engine. Also, transmitting an oscillating motion from the cylinder to the valve lever, for the purpose of moving the valves for their ports to meet those of the cylinder trunnions, and thus cause a quick induction and eduction."

183. For an *Improvement in Hand Rails for Stairs;* J. M. Bull, Sidney, Ohio.

Claim.—"Joining a series of blocks of wood, or other material, together at such angles as will form any circle or curve that may be required, and secure the same together by means of a rod provided with a screw and nut at each end, or any other mechanical equivalent."

184. For an *Improved Fountain Pen;* Newell A. Prince, Brooklyn, New York.

Claim.—"The elastic spring, unfixed in the feeding tube, whether the said spring be placed under or above the pen, it being so placed that it is made to vibrate by the action of the pen in writing. 2d, The under recess formed by inserting the feeding tube in the lower end of the main reservoir tube, the said under recess acting as a receptacle of the ink which reflows when the point of the pen is turned upward. 3d, The combination of the conical part of the piston with a conical seat for the same in the screw cap, so that when the piston rod is drawn outward in charging the main reservoir tube with ink, the hole in the screw cap is closed ink and air tight."

MECHANICS, PHYSICS, AND CHEMISTRY.

On the Motion of Water through Pipes. By HENRY HENNESSY, M.R.I.A.*

A very elaborate series of experiments have been recently made at Paris, on the motion of water through pipes, by M. Darcy, director of the public water works of that city. A memoir detailing the methods of experiment, and the results obtained, having been submitted to the Academy of Sciences, a commission of inquiry was appointed, from which has emanated an extremely valuable report, drawn up by M. Morin, and published in the number of the *Comptes Rendus* which has been just received.

The utility of economizing and properly regulating the supply of water to towns and manufactories, is now so fully recognised—the industrial and social importance of any practical conclusions that may be drawn from well-conducted hydraulic experiments, so completely admitted—that it appears desirable to give the utmost publicity to these investigations.

The experimental and mathematical researches which have hitherto formed the basis for engineering calculations, have generally afforded but little information as to the influence of the condition of the interior surfaces of the pipes on the resistance to the flow of water. Partly resulting from this cause is the fact not unfrequently observed in connexion with great water works, that while the volume of water actually discharged through new cast iron pipes is generally greater than that deduced from scientific rules, as soon as the pipes have been some time in use, and that deposits have been formed in them, the state of things is entirely reversed.

One of the chief objects of M. Darcy's investigations being to clear up practical difficulties of this kind, he proceeded to make a series of experiments, in order to determine—

1. The influences of the state of the surfaces on the discharge.
2. The influence of the diameters of the pipes on the resistance.

He used pipes varying in diameter from the smallest ever used for practical purposes, to half a metre, or a little more than 1 ft. 7½ in. The pipes were also of different materials, some of drawn iron or lead, and some of iron coated with pitch, or of smooth glass, also cast iron pipes, some of them quite new, some old with deposits, and some old without deposits.

The experimental arrangements were such that the observer was able to measure the pressure or effectual head of water in the iron pipes at the origin of movement and at distances of 50 and 100 metres (164 and 328 feet) farther on. The differences would give the measure of the loss occasioned by the resistance of the surfaces.

The leaden pipes, which were 50 metres long, or more than twelve hundred times the diameter of the thickest employed, had the pressures measured at a distance of 25 metres. A similar arrangement was made in the glass tubes, which had nearly the same dimensions. The mean velocities obtained in these experiments varied from 0·03 metres to 5 or

* From the Lond. Civ. Eng. and Arch's. Jour. September, 1854.

6 metres per second; that is, from 1·18-inch to 16 feet 5 inches, or 19 feet 8½ inches nearly; thus going even beyond the limits used in practice. The inclinations and diameters of the several pipes were carefully measured by the most approved methods.

The most important general result deduced from these experiments is, that the nature and state of the interior of the pipes exercise a considerable influence on the discharge.

It appears, for example, that compared with the formulæ of M. Prony, iron pipes coated with pitch give discharges greater than the calculated results, in the proportion of nearly 4 to 3; that glass gives similar results; but that in cast iron pipes, whose diameter had been only very slightly diminished by deposits, the velocities, and therefore the effective discharges, were decidedly less than the theoretical indications, while after a thorough scouring a perfect agreement became manifest.

The diameters of the pipes seemed also to exercise a more decided influence on the discharge than what had hitherto been assigned to them; for with small diameters the results were less than by the formulæ, while they were greater for large diameters. This influence of the diameters was probably overlooked, as suggested by M. Darcy, from the fortuitous compensation established between the resistance in very thin but smooth pipes, and those of considerable thickness but encumbered by deposits.

From a discussion of his experimental results, it follows that the law of resistance is generally expressed by the usual formula:

$$v^2 B + v A = R I$$

R being the mean radius or hydraulic mean depth, I the inclination of the tube due to the resistance, v the velocity of efflux, and A and B constants. But an exception to this law holds in the case of very thin tubes and low velocities, in which case the term B disappears, and the resistance is proportioned to the velocity simply. As might be expected, therefore, the diameter and the substances composing the different pipes have been found to influence the values of A and B, for these have been found to differ in tubes of the same dimensions but of different degrees of internal smoothness, and also in those which were equally smooth but with unequal radii.

In pipes containing much deposited matter, which is usual in those that have been some time in service, it appears from M. Darcy's experiments that the resistance (as admitted by several engineers) could be safely considered as simply proportional to the square of the velocity, thus simplifying practical calculations. These experiments being made with pressures so varied and so considerable, an admirable opportunity was afforded for testing the long admitted principle, that the resistance presented by the sides of a tube to the liquid passing through, is independent of the pressure of that liquid. It was found, for example, that where the head of water varied in the ratio of from about 55 feet 9 inches to 85 feet 4 inches, and again from about 72 feet to 131 feet, between the two parts of the pipe submitted to observation, the differences or losses of head have remained the same for both parts. Such decisive results completely confirm the important hydraulic principle just mentioned.

In order to determine the numerical values of the constants A and B in the formula,

$$v^2 B + v A = R I,$$

M. Morin objects very properly to the use of the method of least squares, as not only requiring very troublesome calculations, but also introducing into the results the influence of mere accidental anomalies, which such experiments sometimes present. He prefers a graphical representation of the actual results of experiments, as being more expeditious, and capable of rendering more palpable such accidental circumstances as may deviate from the usual law. M. Darcy has employed this method simultaneously with that of least squares, and has thus, in a great measure, obviated the imperfections of the latter. Observers in every department of physical science might profit by the hint of M. Morin, as to the successive employment of the two methods; by which, we presume, he means the application, first of the graphical method, so as to detect the accidental anomalies, and then, on their elimination, the application of the method of least squares to the purified results.

After determining the values of the constant coefficients for tubes of different materials and dimensions, M. Darcy has estimated, by the aid of his formulæ, the velocities corresponding to the different inclinations, and has compared them with the observed velocities. This comparison shows, that for all kinds of pipes, and for every diameter, as soon as the velocities attain a few décimètres,* the formula of resistance may be changed to

$$v^2 B_1 = R I,$$

and this will be especially correct for pipes containing deposits; that is, for working pipes in their usual condition.

A comparison of the values obtained for the coefficient which determines the resistance in tubes differing but slightly in thickness, has shown that their different degrees of smoothness, and general condition of their internal surfaces, exercise very remarkable effects on the amount of that resistance. Thus, tubes of thin sheet iron coated with pitch, of clean cast iron, and of cast iron covered with deposits, each having in inches respectively the diameters, 7·717, 7·401, and 9·567, gave for B_1 values which varied proportionally from 1 to 1·5 and 3. This result shows, that in estimating the action of a series of pipes for water works, they should be always supposed to have arrived at the normal condition of being coated with more or less deposit, no matter how comparatively smooth they may be at the time of laying them down.

Having found by experiment that the resistance diminishes with an increase of diameter, M. Darcy sought the law of variation as some simple function of the diameter, and he has shown that B_1, in the formula last given, may be represented by two terms, one constant, and the other varying inversely with the diameter of the tube. The law thus becomes

$$R I = v^2 \left(a + \frac{b}{R} \right)$$

* One decimetre = 3·93708 inches, not much less than 4 inches.

Or if L represent the length of the pipe and H the height due to the resistance,

$$H = v^2 \frac{L}{R}\left(a + \frac{b}{R}\cdot\right)$$

From a series of eight experiments with tubes of drawn and cast iron, sensibly of the same degree of smoothness, and with diameters varying from half a metre down to 0·122 metre, M. Darcy has obtained the following numerical values:—

$$a = \cdot 0000507, \quad b = \cdot 00000647.$$

When the values of R, L, and v are given in English feet—

$$a = \cdot 0000507, \quad b = \cdot 00002122.$$

The expression generally recognised among hydraulic engineers as equivalent to the foregoing, is given by Mr. Neville in the form,*

$$R\,I = v^2\left(a + \frac{b}{v^{\frac{1}{2}}}\right)$$

Where

$$a = \cdot 00005585, \quad b = \cdot 00006659.$$

On making use of these results a very satisfactory agreement was found with observation, so that it was possible to safely calculate the values of B_1 in the formula of $v^2 B_1 = R I$, for all diameters, for every centimetre from the first up to 50, or half a metre, and also for every 5 centimetres up to a metre. By simple transformations of the preceding formulæ, which will readily occur to scientific readers, it is possible to obtain rules for calculating the inclination required for obtaining a given velocity with a certain diameter of pipe, or the converse problem of finding the velocity corresponding to a given inclination.

The variation of the coefficient of resistance, which must be taken into account for narrow pipes, is much less perceptible in those with diameters greater than from about 5 to 6 inches, and it may be considered, without inconvenience, as constant for all those of greater diameter.

M. Darcy has also turned his attention to another question connected with the motion of fluids in pipes, which, although comparatively unimportant for practical purposes, possesses much scientific interest. The point referred to, is the law of variation of velocity of the particles of fluid from the axis of a pipe where it is a maximum, to the surface where it is a minimum. With the aid of a small and very slender Pitot tube, of which one branch could be placed parallel to the axis of the pipe at different distances from that axis, and of a manometer giving the pressure exercised on the surface, he has determined the excess of pressure observed at the Pitot tube over that on the manometer, and by a special process, the velocity of the fluid acting on this tube, or some quantity proportional to the velocity. Comparing in this way, for different inclinations, the excess of velocities in the axis over the velocities at different distances therefrom with the square roots of the inclinations, it followed:—

1. That the ratio of this excess to the inclinations was constant.

* See 'Hydraulic Tables, Coefficients, and Formulæ,' by John Neville, C.E., M.R.I.A., County Surveyor of Louth.

2. That the ratio of this excess to the $\frac{3}{2}$ power of the distance of a moving particle from the axis was constant for the same inclination.

3. That the ratio K of the same excess to the product $r^{\frac{3}{2}}\sqrt{I}$, constant for the same pipe, varies from one pipe to another inversely as the radius, so that $\frac{K}{R}$ is constant.

It is hence easy to infer that the relation between the velocity V, of the particles situated in the axis of a pipe, with the velocity v, of those situated at a distance r, from the axis, is represented by

$$V - v = \frac{Kr^{\frac{3}{2}}\sqrt{I}}{R}$$

Whence, if w represent the velocity of a particle at the surface of the pipe,

$$w = V - K\sqrt{RI}; \text{ or, } K\sqrt{I} = \frac{V - w}{\sqrt{R}}$$

Whence substituting, we obtain,

$$v = V - (V - w)\frac{r}{R}\sqrt{\frac{r}{R}}$$

From which the velocity of any particle may be obtained if the velocities in the axis and at the surface are known.

It finally appears that for the mean velocity u, M. Darcy has deduced the expression,

$$u = \frac{3v + 4w}{7}.$$

By comparing the results of experiments made with different pipes, M. Darcy has been led to conclude, that although the degree of smoothness of the interior of a pipe must influence the resistance, and consequently the mean velocity of the fluid, it does not affect the law of variation of velocities from the axis to the surface, which appears to depend on the viscosity or molecular condition of the liquid.

It seems that the conclusions at which M. Darcy has arrived relative to the coefficient of contraction have not been considered quite satisfactory. It appears from the theory established by M. Poncelet, that the coefficient in question is a function of that at the opening of the tube, which varies with the head of water, the dimensions of the orifices, and the velocity. It follows, therefore, that the coefficient of contraction at the origin of the pipes ought itself to vary with these quantities; but M. Darcy has obtained a constant coefficient, such as is generally admitted, and this only by a compensation of differences. We have very little doubt that a more correct result would have been obtained if he had employed in the discussion of his experiments, the graphical method in the peculiar way to which attention has been already directed.

Here we must conclude our account of these important researches, which we are glad to learn will be published in detail by the Academy of Sciences, in the '*Mémoires des Savants Etranges.*'—*Dublin Monthly Journ. of Industrial Progress.*

On the Progress of Naval Architecture and Steam Navigation.

By Mr. Scott Russell.*

It was mainly (the lecturer said) in respect to speed that the great improvements in the last twenty years had been made. Within that time, the principle and the means of gaining speed had become definitely known, and this Association had had a great deal to do with the establishment of that principle, which consisted mainly in the particular formation of the water-lines of the vessel. The old ships had a round, bluff, duck's-breast bow, with a sloping narrow stern. At length the idea was arrived at of making a boat with a bow, the water-lines of which should correspond with the wave of the sea itself, which should gently and gradually divide the particles of water, which would then give a quiet and easy passage to the vessel entering, whether propelled by steam or by sails, without resisting their progress, and heaping a mound of water before the bows, as in the case of the old bluff, round-built vessels. It seemed now to be universally admitted in Europe and in America, that if a ship-builder wanted to have a very easy and fast-going ship, he must give her bow, not the round convex line formerly adopted, but a fine, long, hollow line, such as the meeting might observe for themselves in all the recently built vessels. Practical men, when they desired to build a fast ship, saw that they must now no longer use the convex water-line, but they must build with a hollow water-line at the bow, and in this consisted the great revolution which had taken place during the last twenty years. Whereas, formerly, the broadest part of the vessel was only a third part from the bow, the broadest part was now nearer to the stern than to the bow in the proportion of two to three, so that the shape of the ship under the water was very nearly reversed. The ship out of the water might remain very nearly the same, but where she cut the water the lines were as he had described. It was on this principle that American clipper ships and English ships which happened to be very fast, were built, and upon which he would say, without fear of contradiction, every vessel, to gain anything like sixteen miles an hour, must be built. Now there was, in addition to this, another very important principle which had been discovered. That was the virtue of the length. It used to be a dogma, in the time of his pupilage, that no steamboat could ever, by any possibility, go faster than nine statute miles an hour. He was born and bred in that belief. Nine statute miles an hour was the creed of his instructor in ship-building. At that time they had very short vessels, and they endeavored, by putting enormous power in them, to compel them to go through the water whether they would or not. He remembered being present at the trial trip of a vessel, out of which had been taken 50-horse power engines, and engines of 70-horse power substituted. It was a most extraordinary fact, that she only gained something like a quarter of a knot an hour by that enormous addition to her power and fuel, because she had not sufficient length to go by any force at a high speed; and the more she was driven through the water, the greater was the resistance made by the water which she

* From the Lond. Prac. Mec. Jour., Dec., 1854.

raised before her. The principle was ascertained, that, if you wanted the particles of water to go out of the way of the vessel when going very fast, you must give the particles more time to do so. Now, this might appear a contradiction in terms, but the faster the vessel was to go through the water the more time must be allowed to the particles of water to give way. It was found that it was more easy to push a vessel with an elongated body through the water at a great speed, than the short vessels which had been in use. This was reduced to a regular principle, the result of which was, that it was now certain that twenty-four feet of length in the entrance lines of a vessel, would give eight miles an hour easily; to go at sixteen miles an hour, the entrance lines should be nearly 96 feet long. To give twenty-four miles an hour, the entrance should be 216 feet long, so that they could not expect to get twenty-four miles an hour until they had made up their minds to build ships something like 400 feet long. From all the experiments he had made, and had seen made, these facts were undoubted. The clipper ships and fast steamers had lengthened their bow-lines until they had got the necessary length for speed; and if those present looked at any vessel which had got the reputation of going sixteen miles an hour, he believed they would find that to be the fact. Indeed, he did not believe there was in existence a vessel shorter than 180 feet which could go sixteen miles an hour; and if there were any such vessel forced to go more than sixteen miles, it was at an expenditure of power which was perfectly preposterous. They would, therefore, perceive why such a large vessel as the *Himalaya* had such great speed. The *Himalaya* had a length of 350 feet, and should have the greatest speed for the smallest power of any merchant vessel hitherto. If, in a like manner, they looked at the large clipper ships of 2000 and 3000 tons burden now built, they would find that the principle was taken advantage of, and that their bows were elongated to a great length. But what else was being done? The owners of the clipper ships were finding out that, by the lengthening of the bow, and making the lines more hollow, they could reduce the sails and spars, and yet preserve their speed, finding that the ships could not do in the water what force of canvas could never alone accomplish. Like every truth, the shape of a vessel had been long since found out and lost again. The London wherry was built as perfectly upon the lines he had described, as if it had been mathematically constructed upon them. In India, the boats were made precisely upon that form, and they were the fastest boats in the world, as a class. The Turkish caiques had the same shape, and they were very fine vessels. In Spain, they had arrived by some means at a form not very different; and throughout the whole of the last war, the Spanish vessels were the best vessels, and the best England took. The smugglers, because they risked their necks upon the speed of their ships, quickly found out what shape was best; and some of the most beautiful ships that ever came into our possession in that way were built in that form. The Americans had made very early an experiment of the kind in steamboats. They lengthened their steamers at a very early period, and they now generally build upon this plan, and with the hollow lines. They had done wonders in this way, and he believed, in England, wonders were also being done. It was not easy to carry the elongating of

the vessels much further in wooden ships, because they could not get timber large enough, and it was impossible to make it strong enough by joining; but he believed Professor Fairbairn had discovered the means of joining iron, so as to make it equal in strength to solid metal. Having alluded to the building of the *Great Western*, and subsequently of the *Great Britain*, and the prophetic doubts expressed at first regarding the fate of each, the speaker proceeded to describe the great vessel now being built by him upon the Thames, for the Eastern Steam Navigation Company, to trade with India and Australia. He showed how the difficulty of carrying coals, and having to stop for them, and buy them at high rates at St. Vincent and the Cape of Good Hope, and sometimes the Mauritius, created such an expense that no freights could cover; he showed how it became necessary to construct a vessel large enough to carry her own coals all the way. When, therefore, he told them that the vessel being constructed was expected to make the voyage to Australia in 30 days, carrying a sufficient freight, with 600 first class and 1000 second class passengers, having three large tiers of decks, 8 feet each in height —that she was 675 feet long, 83 feet beam, 60 feet deep—when he told them, that he had just measured St. George's Hall, and found that it would not fairly represent this ship, being only 169 feet, instead of 675 feet long—that up to the top of the hall it was only 82 feet high, and up to the spring of the arch about the height of the ship—that the breadth of St. George's Hall was only 77 feet, being 6 feet narrower than the hold of the ship, it would give them the nearest approximation he could convey to the size of the vessel. In reply to a question, he stated that the huge vessel which he had described would draw 20 feet when light, and 30 feet loaded.—*Proc. Brit. Association, Sept.* 22, 1854.

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*Purification of Coal Gas.**

Even those who insist on the comparative purity of our metropolitan gas have admitted, so far as regards one of the most obnoxious of its defilements, namely, sulphuret of carbon, not only that it *is* contaminated with this impurity, but that all endeavors to withdraw it, short of destruction of the gas itself as an illuminator, have hitherto been fruitless. It ought to afford the gas companies high gratification, therefore, to learn that it is positively asserted that this grand desideratum has at length been attained, and that the alleged means of withdrawing, not only the sulphuret of carbon, but at the same time the ammonia with which admittedly their gas is also contaminated, are so simple, so available, and so ensily applied, that no new or expensive apparatus whatever is requisite in order to accomplish an end which will not only remove more than one constant source of mischief, but greatly enhance the illuminative power, and hence the value of their gas, and that, too, at a cost to themselves almost nominal. All that is necessary, it is stated, is to use strata of hydrated clay along with the lime usually employed in the purification of coal gas. The efficacy of this mode of purification has already been tested, it appears, at the Wakefield gas-works, on upwards of 3,000,000

* From the London Builder, No. 585.

cubic feet of gas. The discovery is a practical one, which, in fact, has been patented jointly by the chairman of the Wakefield Gas-works, Mr. W. Statter, and another gentleman, also resident at Wakefield, namely, the Rev. W. R. Bowditch.

Hydrated clay, like some few other interesting chemical substances, forms threefold combinations, and so, in this case, effects its purpose. It not only unites, it is said, with the ammonia of the gas as with a base, but at the same time with its sulphuret of carbon as with an acid, and thus removes both of these noxious impurities from the gas exposed to its influence. Its good offices are said to be not even limited to these; as, in alternation with the lime of the usual purifiers, it assists in removing tarry vapor and other impurities.

The illuminative power of the gas, moreover, is thus said to be positively increasable from 22 to 33⅓ per cent.

The following results are given as rather below than above the average of a considerable series of experiments:—

"Feb. 14th, 1854.—Gas made with one-seventh cannel coal:—Lime purification: 5 feet of gas burnt per hour gave light equal to 12¼ sperm candles. Clay purification: 5 feet of gas burnt per hour gave light equal to 15 sperm candles. Gain: Light of 55 candles per 100 feet of gas, or 100 feet clayed equal to 125 limed (nearly).

"March 2d and 3d.—No cannel coal used:—Lime purification: 5 feet of gas burnt per hour gave light equal to 11½ sperm candles. Clay purification: 5 feet of gas burnt per hour gave light equal to 15¼ sperm candles. Gain: Light of 75 candles per 100 feet of gas, or 100 feet clayed equal to 132½ feet limed."

On this point the patentees say:—

"An increase of light, ranging fron 1-4 to 1-5, is an improvement upon which most gas companies would have felicitated themselves had it, and *it only*, been attained by superior management, at a cost of no more than ½d. per 1000 cubic feet: the production of light is the object of gas manufacture, and the advantage just named may be expressed commercially as an increase of about ¼ of the article produced, at an expense of 1-40th of the cost of production—gas being assumed to cost 1s. 8d. per 1000 feet. Practice cannot but receive with gratitude the boon presented for acceptance by her parent Science.

Of course we are not blind to the circumstance that the patentees of this invention have a personal interest in giving as high a coloring as possible to the alleged advantages of their patented discovery. We merely quote their statements in order to show that it is not only the duty but the self-interest of the gas companies to look into this matter, and at least to give the proposed method a fair trial, since they acknowledge that the removal of sulphuret of carbon is a great desideratum which is yet to be realized. There is, moreover, we think, a high probability that there is little or no exaggeration in what is alleged. The result of the use of clay at Wakefield is distinctly stated to be uniformly successful, and to bear out all that is said of its value.

Clay or alumina is one of the cheapest and most abundant substances in nature. Its cost, therefore, is out of the question, even although no positive benefit in increased illuminative power were attainable by its use. The only expense to speak of in testing its utility will be the cost of license from the patentees, which will be as nothing when placed in competition with the alleged advantages. We feel more assured than ever, then, that the day is at hand when our metropolitan gas will indeed be so pure that it will find ready and extensive access to our pri-

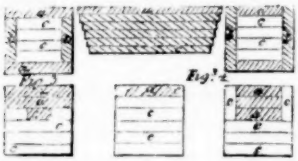
vate dwellings, and that the only points to be further urged to that desirable end will relate to the requisite general arrangements as to fittings and as to ventilation,—both of these points of great practical importance, to which we have repeatedly drawn attention, and on which we shall yet again, and very soon we hope, have more urgent reason than ever to dwell.

To JOHN DAVIE MORRIES STIRLING, *near Birmingham, for improvements in the manufacture of rails and parts of railways, and tyres of railway wheels.*—[Sealed 27th August, 1853.]*

This invention has for its object the piling certain descriptions of iron for the purpose of being rolled into bars, for the rails of railways, for switches and crossings of railways, and for tyres of railway wheels, and consists in piling bars of iron rendered crystalline by means of tin, antimony, arsenic, or bismuth, with bars of other iron (combined or not with zinc), to give fibrous character to the interior and other parts of such compound bars; the crystalline iron coming to the wearing surfaces.

Figures 1 and 2, show two piles of iron; the outer plates *a*, *a*, and *b*, *b*, being of that kind of iron known as "Stirling's patent hardened iron," and which is manufactured according to the improvements described under previous letters-patent granted to the present patentee. In the piles, fig. 1, the edges of the side plates *b*, *b*, are covered by the top and bottom plates *a*, *a*: whilst in fig. 2, this arrangement is reversed; the side plates *b*, *b*, covering the edges of the top and bottom plates *a*, *a*: the object being to enclose the more fibrous iron *c*, of which the interior of the piles is composed, with iron, hardened by the use of tin, antimony, arsenic, or bismuth, as is now well understood. The bars rolled from the piles, figs. 1 and 2, are intended for, and will be found very useful in, constructing the wing and point rails of railways. Figs. 3 and 4, show three forms of piles suitable for being rolled or formed into flanched or unflanched tyre-iron for railway wheels. In each of these cases the plates *a*, *a*, are of the patent hardened iron above mentioned, and the other plates *c*, *c*, are of the more fibrous iron. The number and thickness of the plates composing the piles may be varied, so long as the arrangement of the fibrous and crystalline iron is such as described. The patentee observes, that he prefers, for the more fibrous parts of each pile, to employ that description of iron which has been rendered more fibrous by the use of zinc, as described by him under former patents; but other fibrous iron may be used in place thereof. In making piles of fibrous and hardened iron, more especially when intended for tyres, it is recommended to pile the iron so that the bar or bars, which are intended to form the wearing or flanched surface, should be made longer than the other bars of the pile, and that the pile should be constructed as is shown in

Fig. 1. Fig. 5. Fig. 2.



*From the Repertory of Patent Inventions, June, 1854.

fig. 5; care being taken by the workman that the projection of the upper bar or bars (if the pile be placed upon the smaller base) be not to such an extent as to endanger the burning of the projecting parts when in the furnace. It is also recommended that, where the hardened bar or bars, as above described, do not extend over the whole width of the pile, they be formed, as shown in fig. 4, narrower in the upper surface than on the lower; and that the outside bar or bars of fibrous or common iron, which form the remainder of the upper surface of the pile, shall have a corresponding angle, as shown.

The Iron Industry of the United States. Abridged from PROF. WILSON'S *Special Report on the New York Industrial Exhibition.**

The duties of the commission confided to Professor Wilson's charge, comprised those classes having reference to "Raw Materials" and the industries immediately connected with them. To these were added the examination of the machines and implements used in agriculture, and of certain branches of manufacture in which chemical principles were directly involved. The most important of all the mineral industries,—certainly as far as commercial relations with this country are concerned,—is the iron industry, and to this his attention was especially directed.

The distribution of the various metallic minerals in the different States is somewhat irregular, the rarer metals, as gold, being found but in few localities; tin only to a limited extent, in one place; lead and copper, which are found generally associated together, and occurring to a greater or lesser extent in most of the States; while, happily for the country, iron is met with everywhere, in some places forming deposits of enormous magnitude, and in others, compensating for its diminished quantity by the richness of its ores.

The ores found in the States comprise every variety known in Europe, save, perhaps, that of our own country, the "blackband." Those principally used for smelting are the magnetic oxides, the hæmatites, and the clay carbonates of the coal measures; besides these, the "spathic," or "sparry carbonate," and the "oligist" or specular iron are used, but at present only to a limited extent. The magnetic oxides and the hæmatites are dispersed pretty generally throughout the whole extent of the Union, from Maine to Texas, and from the Atlantic sea-board to the States of the far west. The clay carbonates are associated with the coal measures lying west of the Appalachian chain. In general they are not so rich as those in our own country, but when mixed with the hydrated hæmatites, which are met with skirting the coal districts, these lean ores are very advantageously worked up. They are also found in considerable deposits on the Atlantic side of the mountain chain, in Philadelphia,† Maryland, Virginia, and North Carolina. The spathic ores are not met with to any great extent; they are found in different localities in Connecticut and in Vermont, and when worked in the old method with charcoal and the ordinary cold blast, they furnish iron of first-rate quality.

* From the Journal of the Society of Arts, No. 98.

† [Pennsylvania.]

The specular iron ores occur in the New England States, and in New York State to a limited extent; in the more distant States, both of the South and West,—Texas, Arkansas, Missouri, Iowa, and California, they are reported to be present in great abundance.

The very general distribution of iron ores throughout the Union, and the abundance of fuel which the natural forests everywhere readily supplied, gave facilities for the manufacture of iron, which in the early days of the industry was carried on in various parts of the States, and in many formed the only sources from which the inhabitants could obtain their scanty supplies. Possessing in common with the other States both of the raw materials,—the ores and the fuel,—the New England States, owing to the advanced education and general commercial energy of her people, led the way in identifying themselves with the new industry, by forming establishments where it was carried out on a more extensive scale. Gradually, however, the existence of mineral fuel in Pennsylvania gave an advantage to that State which soon showed itself by the rapid growth of her iron industry. This continued annually to increase, while the scarcity of fuel in the New England States rendered them less able to meet the increasing demands of the market which they themselves had principally created. In 1830, anthracite coal was successfully used in smelting ores, and when, some few years later, it was shown that the hot blast could be as advantageously applied to anthracite as to other furnaces, this State became at once the great centre of the industry, and speedily assumed the control of the home market. This position she has held up to the present time, and must hold it for some years to come, until the iron-making resources of the States west of the Alleghanies are sufficiently developed to enable them to compete in production with their more advanced neighbors.

These great resources are as yet but very imperfectly known; geological investigations have long ago made known the existence of beds of fuel to a boundless extent, and so disposed as to offer natural facilities for working which cannot be without their results on the industrial uses to which they are applied. With these beds are associated, probably throughout the greater part of their area, beds of ironstone similar to that which we find in the coal measures of our own country. These give to this region a material advantage over that east of the mountain range, where the coal formation is entirely destitute of the ore beds which seem to be so bountifully distributed throughout the great bituminous coal-field on the western side. Thus while the smelting furnace in the one district finds a ready supply of both ore and fuel immediately at hand, the location of the other has to be determined by calculations based upon the comparative cost, and other circumstances attendant upon the transport to the furnace of the two necessary materials, the fuel and the ores.

The manufacture of iron has hitherto distributed itself on the line of the great rivers, which are the natural feeders to the canals by whose medium the produce has been conveyed to the consuming districts. Thus we find the chief seats of the iron manufacture to be:—1. On the Housatonic river traversing the State of Connecticut. The production of this district is limited to charcoal iron, of the best quality, obtained from the hæmatite scattered along the shores of the river. Spathic iron ore has

recently been discovered at Roxburg and Munro. The make of this division is consumed chiefly in the immediate district. 2. On the Hudson river, traversing the State of New York, in a line nearly parallel to the former river. On this line a large production of iron by anthracite coal, which is delivered at an average rate of 3 dollars 50 cents per ton, is rapidly springing up. The rich magnetic iron ores (iron 71·79, oxygen 28·21) which are traced for miles along the western sides of Lake Champlain, yielding from 60 to 65 per cent. of metal on the furnace, can be mined and delivered to the coal on the Hudson at an average cost of 3 dollars per ton. On the Hudson there are six large anthracite furnaces, and on Lake Champlain three more; but in the latter district the chief production is with charcoal, the ore being made in a kind of Catalan forge or bloomery. 3. On the Delaware and Lehigh rivers, the former of which separates the State of New Jersey from Pennsylvania, and empties itself into the Atlantic at Cape May; and the latter joins the Delaware at Easton, about 270 miles up. The Lehigh leads straight up to the north-east extremity of the first great anthracite basin, known as the "Schuylkill." Easton is about equidistant from the anthracite coal-field of Pennsylvania and the primitive ore range of New Jersey, while all around, there are extensive beds of hæmatite, yielding about 40 per cent. of metal. The Trenton Iron Company at this place have three large furnaces in operation—two with a diameter of 20 feet, and one of 22 feet, —giving an average production of from 500 to 600 tons per week. On looking over the returns, which were liberally shown, some extraordinary runs were observable, amounting to upwards of 240 tons per week from the 20 feet furnace, and continuing at that rate for several weeks together. Higher up the river are the works of the Glendon Iron Company, containing four large blast furnaces. Here, in order to economise space in the engine house, the blowing cylinders are placed immediately over the steam cylinders of the engine, so that the same piston rods, by a reciprocating movement, work the two cylinders at the same time. At Catasauqua the first furnaces in the States for the use of anthracite iron were erected, and Mr. Crane, in the year 1837, here first successfully applied hot blast to anthracite in iron smelting. In all the works visited economy of production was strictly adhered to. The air was heated by the waste gases of the furnaces, and in most cases the whole steam power, whether for driving the blast or for other purposes, was generated in boilers set in the upper part of the furnace, and arranged so that the heated gases played around them. 4. On the Schuylkill river, which runs into the Delaware a short distance below the city of Philadelphia, there are found, throughout the whole length of the valley, large deposits of hæmatite ores; these, however, are not so rich as those of the Lehigh; while the supply of the primitive oxides and carbonaceous ores is very scanty. Upon this river there are 18 blast furnaces using anthracite coal. Besides these, there are several small charcoal furnaces, whose fires are gradually waning away, though they still support the character of the American iron by the very excellent article produced. 5. The Susquehanna, another of the great parallel rivers running from the highlands of the interior down to the ocean, and which debouches, just below Havre-de-Grace, on the upper extremity of Chesapeake Bay, has along

its banks large deposits of iron ores. As it traverses the three large coal-fields, the Shamokin, the Schuylkill, and the Wyoming, and is well supplied with artificial modes of transport, it offers very great advantages in the manufacture of iron. 6. The Potomac, taking its course some 60 or 100 miles south of the Susquehanna, and running into Chesapeake Bay about midway from the ocean, is abundantly supplied with ores, chiefly hæmatites of good quality. Charcoal is the fuel chiefly used, although the increasing means of communication with the Cumberland coal-field, and also with the anthracite basins of the Susquehanna, have given great advantages in the way of fuel to those furnaces placed within reach of the lines of transport. 7. The Ohio, and the Cumberland and Tennessee, are still only partially developed, charcoal as fuel, and the hæmatite ores, which are found on the outskirts of the great Appalachian coal-field, being the sources from which the principal portion of the iron is now produced. In the upper part of the Ohio, in the Pittsburg district, more progress has been made; the furnaces are being worked with raw bituminous coal, and with the clay carbonates mixed with hæmatites. Limestone is also found in the immediate vicinity. Besides the production of these eight principal iron districts, a large quantity is made in widely dispersed localities, with charcoal as fuel, in small blast furnaces, or in the primitive forges or bloomeries. The gross amount of iron produced in the several States of the Union for the year 1850, as given in the Census returns, is 540,755 tons. The number of hands employed is given at 20,298, and the market value of the produce is estimated at 12,489,077 dollars. Taking the present production of pig iron at 800,000 tons, about one-half of it is consumed for castings, and the remaining portion is left to be converted into wrought iron, at a loss in waste, &c., of about one-third. This, for practical purposes, reduces the total or available production about 130,000 tons, and leaves in round numbers 700,000 tons to meet a consumption of not less than 1,200,000 tons. This deficiency must be supplied by the produce of other countries.

The number of establishments for the conversion of pig into wrought iron in the United States is given in the Treasury returns at 422. These establishments have an invested capital of between fourteen and fifteen million dollars, and give direct employment to upwards of 13,000 workmen. The total amount manufactured in the States may be taken at 500,000 tons per annum. In general, the wrought iron works are carried on as a distinct business from the manufacture of pig iron. The following establishments, however, combine the whole process of smelting and puddling: the Trenton Iron Company, at Easton and Trenton, New Jersey; Fuller and Lord, at Boonton, New Jersey; Reeves, Buck, and Co., Phœnixville, Pennsylvania; Reeves, Abbott, and Co., at Safe Harbour, Pennsylvania; the Montour Iron Company, Danville, Pennsylvania; and the Mount Savage Iron Company, Maryland. The principal cause of the separation of the two branches is probably due to inadequacy of capital to carry on both. Rolling mills for plate and bar iron are met with throughout the States in which iron is produced. In Pennsylvania the establishments for the conversion of cast into wrought iron are numerous. At one of the country rolling mills charcoal blooms were being used, which were first worked up in a puddling furnace, and then tilted; after

which they were again heated, and rolled out into plates of the required dimensions. Charcoal boiler plate fetches a higher price, and is always guarantied by the maker, as, owing sometimes to an imperfect process of reduction in the forge, a small portion of the fuel is left mixed up with the metal, and remains even after it has passed the puddling furnace and the tilt hammer. To detect the flaw in the iron when rolled out requires great care on the part of the foreman, who carefully notices, after it has left the rollers, whether the surface cools equally all over; if any black spots appear, they show that the plate is imperfect and contains cavities in which carbonaceous matter is usually found. The spots are then marked, and the plate laid aside. In the hands of the engineer they again undergo an examination; the practice of the boiler-makers being to rule them off in one-inch squares, and then test each square with the hammer, the expenses attending any unsoundness falling upon the maker.

A process, patented by James Renton, in 1851, for making wrought iron direct from the ore, is being carried out upon a commercial scale at Cincinnati, in Ohio, and at Newark, in New Jersey. At the former place the furnace was of a peculiar construction, resembling in shape an ordinary puddling furnace, at the extremity of which is a chamber of the following dimensions,—10 feet high by 6 feet broad, and 7 inches wide,—was built up in fire bricks, forming, in fact, a kind of large vertical muffle or retort; this was entirely surrounded on the sides by the flue or chimney of the furnace. When in operation, this muffle or retort is filled with a charge of ore and coal, both finely broken, and carefully mixed up together in the proportion of about 20 to 25 per cent. of coal, to 75 to 80 per cent. of ore. The muffle in question held a charge of 12 cwts. The heated gases from the furnace playing round it raise the temperature of its contents sufficiently to induce combustion of the carbonaceous matter, which is carried on slowly at the expense of the oxygen of the ore. When the ore is sufficiently deoxidized, it is discharged from the bottom of the muffle as required into the "welding furnace," where the heat is considerably increased, and the iron is readily worked up into balls, and thence taken to the hammer in the usual way. The iron by this process cannot be said to be puddled, as the ore never melts, but, having first been deoxidized in a close chamber, is simply welded together in what the patentee terms "an ore welding furnace." He appears to consider that the great merit of the process lies in the use of the closed chamber, in which the iron is perfectly protected from the wasting effect of the flame and gases of the furnace during the process of reduction, which would otherwise, as they always do, oxidize and slag the ores;—the probable reason why all attempts have failed to work the ores in open chambers. The temperature at which the deoxidizing action is carried on is not high enough to cause the iron to combine either with the carbon of the fuel, or with any of the impurities, as silica, phosphorus, &c., which are always found in common cast iron. The balls were drawn from the "welding furnace" for tilting every half-hour, their size depending upon the quality and yield of the ores that were being used. When the works were visited, a moderately rich hæmatite, yielding about 35 per cent. of metal, was being used, and the balls weighed about 80 lbs.

each. The average yield obtained, it was said, was 45 per cent., and the weight of the balls 100 lbs.

In the smelting furnaces (anthracite) the practice of economizing fuel by the application of the waste gases to raise the temperature of the blast, and also to generate the steam power necessary for the works, is carried out to a far greater extent than with us, and certainly merits a passing acknowledgment.

There is a very important labor saving machine in general use in most of the rolling mills, in the shape of a "*rotary squeezer.*" This is fully as effective and much quicker in its operation than either the old hammer or the lever squeezer, termed the "alligator" in Wales; at the same time by its rotary action it saves the labor of turning the ball during the operation. The machine, though simple in construction, is necessarily made very heavy and strong to withstand the strain while at work. It consists of a fixed circular case in cast iron, with ribbed or fluted sides, surrounding a stout vertical ribbed roller, and eccentric to it, which is fixed on to a shaft and pinion, by which it is driven at high velocities. The ball is introduced into the "squeezer" at the widest part, and is rapidly carried round under an increasing (eccentric) pressure. The cap or top is made to move vertically, so as by its weight to accomplish the upsetting of the blooms ere they pass round. The invention is due to Mr. Burden, but has been subject to many close imitations, which have quite recently occupied the courts of law in the State of New York. At the Fall River Mills, a "rotary squeezer" (Winslow's patent) applies the same principle in a vertical instead of a horizontal direction. In this case a spring hammer is attached at the side, which strikes the ball at the end as it is passed through the squeezer.

The only other point of interest in connexion with this industry is the method of utilizing the slags of iron furnaces, which was illustrated by Dr. W. William Smith, of Philadelphia, in the New York Exhibition, in Class XXVII., where a collection of bottles, slabs, bricks, and other articles, run direct from the reducing furnace, were exhibited. The finish and appearance of the various articles would justify the expectation that the process, if applicable to the slags of coal furnaces generally, would be of great industrial importance. The price was about 4 c. per cubic foot for slabs.*

At present the United States is mainly dependent upon this country for its supply of steel. This circumstance is due entirely to the infancy and the undeveloped condition of its iron industry, inasmuch as the Ameri-

* Slag as a Material for Fictile Purposes.—Some time ago, Mr. Elliott, of Blisworth, made a very satisfactory attempt to establish the manufacture of bricks and tiles from the slag, or refuse cinder, of blast furnaces. Now, we have a further movement towards a similar end, at the hands of Dr. Smith, of Philadelphia, who, with a staff of chemical assistants, is at present engaged in the matter at Merthyr. His experiments have been made with the view of producing bottles, and domestic utensils of various kinds, as well as tiles and paving-flags; and this mode of converting the enormously accumulating cinder of the iron works has been decidedly successful. The new bottles are tougher and more perfect in their annealment than any of the ordinary glass kind; but they are undistinguishable from glass ones in external appearance. Lady Charlotte Guest has adopted the process, and it is believed that not much time will elapse before the transmutation of what has hitherto been a constantly increasing waste mass, will be a commercially valuable fact.—*The Practical Mechanics' Journal* for October.

can iron is in itself well adapted for conversion into steel, while in this country we are obliged to import our supply of steel iron from the north of Europe. The consumption of steel in the States has increased largely in the last ten years, and with the returning prosperity of the iron interests we find the establishments for the manufacture of steel increasing likewise. In 1840, the Treasury returns gave the importation of foreign steel at 44,506 cwts., and in 1850, at 127,517 cwts. The manufacture of steel is principally carried on in Pennsylvania; Philadelphia being the seat of the manufacture in the east, and Pittsburgh in the west.

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*Pendulum Test of the Earth's Mass.**

It has been known for some time that Professor Airey, the Astronomer-Royal, was engaged in scientifically investigating some important questions as to the density or mass of the earth, in Harton Colliery, on the banks of the Tyne. These experiments are now completed, although no detailed result has yet been arrived at, and we are, therefore, so far only in a position to explain the operations themselves. In connexion with this subject many of our readers will recall to mind, the *Schehallien* experiment of Dr. Maskelyne, made in the latter part of the last century; the *Cavendish* experiment, followed up by several foreign inquirers, and in this country by Baily; and, thirdly, a set of observations made by Mr. Airey and Dr. Whewell, in Dolcoath Mine, Cornwall, in 1826--28. These last experiments were precisely similar to those adopted at the present time in the Harton Colliery; but from some accidental causes, united with the great difficulty of ascending and descending the mine by perpendicular ladders, the observations were exceedingly doubtful. The adoption of galvanism in the regular routine of observation at the Royal Observatory, Greenwich, which forms a very important part in the present experiments, made the Astronomer-Royal anxious to repeat his former mining experiment, and Harton Colliery was selected for the purpose of again going into the matter; it is about two miles south of South Shields, and is well adapted for the purpose, being one of the deepest coal mines in the neighborhood. The lower station was 1260 feet below the surface of the earth. The observations consist in noting the vibrations of an invariable pendulum on the surface, and another at the bottom of the mine, both being mounted on firm iron stands in a manner similarly to each other. These pendulums hang on knife-edges, resting on agate planes, thus sustaining little resistance from friction. If swung in vacuo, the vibrations would probably continue for 24 hours; and in their state, as used, though liable to hindrance from atmospheric causes, yet the vibrations will continue at least eight or nine hours. Corrections are applied to the results for the effect of temperature, and also for buoyancy, or the effect produced by the pressure of the air on the pendulum. The vibrations are counted by the assistance of a clock, which is mounted immediately behind the detached pendulum, and thus, by the aid of a clock, the number of vibrations in a certain time can be easily noted. The method is simply this:—To the centre of the

* From the Lond. Prac. Mech. Jour., Dec. 1854.

bob of the clock pendulum is attached a small oval-shaped disk, covered with gold leaf, and illuminated by a lamp. It is necessary in the adjustments that this disk, when stationary, should be hid by the detached pendulum, and that there should be a slit in the clock case, which should also be just covered by it. A line, therefore, drawn through the centre of the telescope, which is placed at a little distance, through the detached pendulum, the slit in the clock case, and the illuminated disk on the clock pendulum, should be a straight line. Suppose the two pendulums set swinging, we should soon perceive that one was vibrating faster than the other, and that the disk would be gradually approaching the detached pendulum until it would be completely hid, and both pendulums would be going exactly together. This is called a coincidence, and is carefully noted to the nearest second of time. When the illuminated disk has re-appeared, which is generally in a few seconds, one pendulum will still continue gaining on the other until another coincidence takes place. The time is again noted, and thus we have the interval of coincidence, or the time occupied in one pendulum gaining two seconds over the other. The rate of one pendulum over the other is easily found, and, as this operation is performed simultaneously at the upper and lower stations, nothing remains but the comparison of the two clocks. In the Astronomer-Royal's former experiments in Cornwall, this was the most difficult part of the operation. At that time it was necessary to fasten the chronometers to the body by means of straps, and then to ascend or descend by perpendicular ladders—a journey which occupied considerably more than an hour in its accomplishment. In the present experiments this section of the observations is quite, if not more satisfactory than the observations of coincidences. This is owing to the adaption of galvanism to astronomical purposes, and by this means the comparison of the clocks is effected. A wire, properly coated with gutta percha, passes from one pole of the battery through a clock, which is so arranged as to push a spring, causing a galvanic circuit every 15 seconds. From the clock the wire passes through a galvanometer attached to the clock-case at the upper station, thence underground to the shaft, down which it descends to the lower station, where it passes through another galvanometer, also attached to the lower clock case. It then returns up the shaft to the other pole of the battery, and thus the circuit is completed. Signals were simultaneously observed by the observers at the upper and lower stations, which give a direct comparison of the two clocks. By this means we have every element for the determination of the gain or loss of the upper pendulum over the lower, and, consequently, the difference of the force of gravity acting on both pendulums is by calculation found. The observations extended over a period of three weeks, the pendulums remaining the first week in the same positions. In the second week they were reversed, so as to eliminate any error which may attach to either pendulum. In the third week they were reversed in the middle of the week. No result has yet been obtained, as the discussion of the large mass of observations will require considerable time and attention; but enough has been done to show that the observations are of a very superior character, and it is the Astronomer-Royal's opinion that most valuable results will be obtained from them.

The observers employed were selected from the principal observatories in England—Mr. Dunkin, of the Royal Observatory, Greenwich, who, in the absence of the Astronomer-Royal, had charge of the experiments; Mr. Ellis, also of the Royal Observatory; Mr. Pogson, of the Radcliffe Observatory, Oxford; Mr. Rumker, of the Durham Observatory; Mr. Criswick, of Cambridge Observatory; and Mr. Simmonds, of Mr. Carrington's private observatory, Redhill, Surrey.

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*Relative Fuel-value of Alcohol and Wood-spirit.**

Bolley has made some comparative experiments to ascertain this point. The wood-spirit used was slightly yellow and empyreumatic; the density was 0·81; it began to boil at 154°·4 Fahr., and then the boiling point rose gradually. It had a slight acid reaction, and the color became darker on the addition of caustic soda or sulphuric acid.

The alcohol had a density of 0·845.

The apparatus employed for these experiments consisted of a lamp for the combustion of the spirit, the burner being surrounded by a cylinder 8 inches in diameter, and a light brass pan supported above the flame for holding the water to be evaporated. Each experiment extended over about two hours. In each, the true quantity of water evaporated and quantity of spirit burnt were observed. The quantity of water, at 212° F., remaining in the pan was likewise observed, the quantity of steam that would have been produced by the heat thus consumed calculated, and added to the quantity of water evaporated. One fraction of the effect, the heat consumed in raising the water from 62° to 212°F., is not included in the table below:

		A. Consumption of fuel in grammes.	B. Evaporation of water in grammes.	Ratio of B to A.	Duration of experiment in minutes.
Wood-spirit,	1.	98	514°	5·25	101
	2.	133	697	5·25	149
	3.	124	597	4·81	138
	4.	198	782	3·95	165
Alcohol,	5.	160	680	4·25	104
	6.	178	781	4·38	148
	7.	133	590	4·43	119
	8.	159	687	4·32	170

In the experiments 1, 2, 3, and 6, 7, 8, the distance between the bottom of the pan and the level of the wick was always the same. In order to ascertain the influence of the greater elevation of the pan, it was raised in experiments 4 and 5 about three-quarters of an inch further from the flame. The result showed a loss in this case.

According to the first three and last three data, the heating capabilites of alcohol and wood-spirit are as 43 : 50, or nearly 6 : 7. The prices, however, were as 8 : 6; consequently, the cost of evaporating a given quantity of water by means of alcohol would amount to 56, while with wood-spirit it would be only 36; or wood-spirit, under such circumstances, would be nine-fourteenths cheaper fuel than alcohol.—*Schweizerisches Gewerbeblatt*, June, 1854.

* From the London Chemical Gazette, No. 295.

*Lightning Conductors.**

You have done me the favor to report what I said at Liverpool about lightning conductors. It is to me astonishing that the accounts of what passes in hasty conversation are so accurate as they are, and I should not have troubled you with anything like a correction, but that one or perhaps two slight errors in what I said, or ought to have said, has misled others. I did not say that I had been consulted about the application of a conductor to the Duke of York's pillar; but that when I inquired why it was affixed so as to be a great disfigurement to the erection, the parties who supplied it told me it had not been asked for until the column was completed. A little lower, the account says that certain contrivances for insulation are *absurd;* a better word would be *useless.*

M. Faraday.

Water Pipes.†

Mr. Waite, of Leeds, has patented water pipes formed internally of white delph, with a glazing like that of porcelain, and surrounded and compacted with a thick covering of a sort of concrete, forming a strong and impervious substance, it is said, not liable to decay, and as capable of resisting violence as iron pipes, and more economically produced. They are also said to be well adapted for gas pipes, and to be so air-tight as to prevent leakage.

Stand Pipe of the West Philadelphia Water Works.

To the Editor of the Franklin Institute Journal:

We noticed in the *Civil Engineer and Architects' Journal*, of September, 1854, page 33, a cut and description of the Stand Pipe for the 24th Ward. In this article, the design and working drawings are claimed by Mr. H. Howson, who was, for a short time, a draftsman employed by us, while the Stand Pipe was in progress of erection. This claim is entirely false and unfounded; the design was made before he was employed by us.

A lithograph of the Pipe was made for the Watering Committee of West Philadelphia, and extensively circulated, with our names appended as the Engineers. In this, the Pipe is represented as surmounted with a statue of "Washington," in place of the spire as it now is; the statue was placed upon the drawing at the suggestion of a member of the committee.

At the time the Stand Pipe was raised, notices were taken of it, and descriptions published in many of the papers of the day, in all of which our names only are mentioned. In *Gleason's Pictorial*, of March 26th, 1853, page 210, is published a cut and description of the Stand Pipe; in this our names only are mentioned. One of the lithographs was exhibited by us, as our design, at the monthly meeting of the Franklin Institute, May, 1853.

A large drawing of the Pipe was also exhibited (at the Exhibition of the Franklin Institute, in October, 1853,) by Mr. Howson himself, with our names as the Engineers; and in none of the above instances did he

* From the Lond. Builder, Nov. 1854. † Ibid.

advance any claim for the design; nor were we aware of his having made any claims until we saw the article in the *Civil Engineer and Architects' Journal.*

Had he made the design and working drawings, he could certainly have described the Stand Pipe with more accuracy than he has done. The following are some of his descriptions in the article above mentioned:

1*st.* He says, "a branch pipe of 12 ins. diameter, which communicates with the distributing main, passes through an opening in the masonry, through the main foundation plate, and is so connected to the cast iron base plate of the Stand Pipe that the water may have free ingress and egress." There are two mains of 16 inches diameter, one by which the water enters through the side at the bottom, another which passes through the bottom and up some distance in the Pipe, through which the water passes out.

2*d.* He says, "to the height of 36 feet above the ground, is built of cut stone." It is built of cut stone to the height of 32 feet 4 inches, and with stone faced with iron 4 feet 8 inches; in all, 37 feet.

3*d.* He says, "The projecting cornice at the upper portion, is 20 feet across." It is 19 feet 8 inches.

4*th.* He says, "The gothic door way is 8 feet high and 3 feet wide." It is 6 feet 10 inches high, and 2 feet 6 inches wide.

5*th.* He says, "The stairway terminating at an octangular landing 17 feet across." It is 16 feet.

6*th.* He says, "The plate iron spire is 9 feet 6 inches in height." It is 8 feet, and with the ball, 10 feet.

7*th.* He says, "The whole height, from the ground to the top of the spire, is 140 feet." It is 160 feet as the lot is to be graded, and 170 feet as it is now.

8*th.* He says, "The landing is 114 feet 8 inches." It is 115 feet.

We might mention many other mistakes, but these will suffice.

The modified valve gearing for the engines, to which he also lays claim, were adopted by us from drawings which we procured from England.

His claim for the design of the engines we are now constructing and erecting for the 24th Ward Water Works, is also false and unfounded.

We submit the above for your consideration, and hope we have not encroached too much upon your time or patience.

Very respectfully, yours,

BIRKINBINE & TROTTER.

P. S.—We understand that Mr. Howson has several affidavits sustaining his claim. We have made diligent inquiry to find who they are by, and can find none made by the parties who *only* could know anything about it.

We send you several of our affidavits, which you will please return when you are done with them. Yours, B. & T.

Remarks.—The affidavits referred to, appear to establish the fact that the design of the Stand Pipe was due to Mr. Birkinbine, and that Mr. Howson was merely employed with other draftsmen under his personal superintendence. EDITOR.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, February 15th, 1855.

John C. Cresson, President, in the chair.

John Agnew, Vice President,
John F. Frazer, Treasurer,
Isaac B. Garrigues, Rec. Sec., } Present.

The minutes of the last meeting were read and approved.

A letter was read from the Philadelphia Society for the Promotion of Agriculture; the Circular of the Pennsylvania Commission to Universal Exhibition, Paris, 1855, was laid on the table.

Donations to the Library were received from the Royal Institution of Great Britain, and the Institute of Actuaries, London; Hon. Joseph R. Chandler, U. S. Congress; Prof. J. H. Alexander, Baltimore, Md.; the American Institute, City of New York; M. V. Baker, Esq., Pennsylvania Legislature, and Prof. J. C. Cresson, the Mine Hill and Schuylkill Haven Railroad Company, and the Philadelphia Society for the Promotion of Agriculture, Philadelphia.

Donation to the Cabinet from Dr. B. Howard Rand.

The periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement of the receipts and payments for January.

The Board of Managers and Standing Committees reported their minutes.

The candidates for membership in the Institute (5), were proposed, and the candidates (10), proposed at the last meeting, were duly elected.

The Standing Committees for the ensuing year were appointed by the President, and approved as follows:

On the Library.	*On Cabinet of Models.*	*On Exhibitions.*
John Allen,	Robert C. Cornelius,	John E. Addicks,
James H. Cresson,	James Dougherty,	John Agnew,
George Erety,	Fred. DeB. Richards,	Geo. W. Conarroe,
Samuel B. Finch,	Edward P. Eastwick,	James H. Cresson,
Raper Hoskins,	Geo. C. Howard,	Owen Evans,
James Lukens,	Israel W. Morris, Jr.,	Joseph Harrison,
Wm. S. Levering,	Chas. J. Shain,	Samuel V. Merrick,
John P. Parke,	William Smith,	John H. Towne,
Clement W. Smith,	Chas. Welsh,	Isaac S. Williams,
Thomas S. Stewart.	Thomas F. Williams.	Thomas J. Weygandt.

Cabinet of Minerals and Geological Specimens.	*On Meetings.*	*Cabinet of Arts and Manufactures.*
Isaac H. Conrad,	Washington Jones,	James C. Booth,
John F. Frazer,	Daniel Leeds,	Thomas Bickerton,
F. Augustus Genth,	J. Vaughan Merrick,	George M. Conarroe,
John L. LeConte,	Edward Mason,	B. Barton Gumpert,
Angus N. Macpherson,	Wm. C. McRea,	Wm. H. Hazzard,
John S. Powel,	B. Howard Rand,	J. Hall Rohrman,
B. Howard Rand,	Fairman Rogers,	Jas. M. Sommerville,
J. Hamilton Slack,	George W. Smith,	Wm. M. Uhler,
Laurence Turnbull,	Marshall B. Smith,	Thos. J. Weygandt,
John C. Trautwine.	Laurence Turnbull.	John Wallace.

On Meteorology.

F. A. Bregy,	E. Otis Kendall,
Owen Evans,	Alfred L. Kennedy,
John F. Frazer,	James A. Meigs,
Laurence C. Francis,	Edward Parrish,
James A. Kirkpatrick,	George J. Ziegler.

Washington Jones exhibited the working model of a novel and very ingenious plan of gearing, designed to increase the speed of propeller shafts above those of their attached engines. The right to use the plan upon boats navigating the Delaware, has been purchased by a company, who are having an engine fitted with it to test its claims. It consists of a bevel wheel with internal teeth, into which works a bevel pinion. The wheel does not rotate, but is securely fastened to a base plate bolted to the bottom of the boat. The pinion is keyed on a shaft which is attached at one end, by a universal joint, to the engine shaft; the other end has a journal upon it working in a box fitted in a crank, of convenient length, keyed on the propeller shaft; the centre line of the pinion shaft, of course, forming an angle with the centre line of the engine and propeller shafts. The ratio of speeds is determined, not by the relative number of the teeth in wheel and pinion, but by their difference divided into the number of those in the pinion. For instance, the wheel in the model has thirty-three teeth; the pinion, thirty; difference, three; then, 3 : 30 : : 1 : 10. Motion being given to the engine shaft, and communicated to the pinion shaft by the universal joint, the pinion rolls round the wheel; being held in gear during its revolution by the rotation of the crank upon the end of the propeller shaft, which has motion given to it by the journal upon the end of the pinion shaft, and whose centre line falls in a plane passing through the centre line of the pinion shaft, and the point of contact of pitch lines of wheel and pinion. The pinion and its shaft performs the functions of a bent lever of the first order, the teeth of the wheel and pinion in contact being the fulcrum; the journal on the end of the shaft being the application to the weight. As, in levers of this order, the weight moves in a direction contrary to that of the power, it follows that the propeller shaft turns in a direction opposite to that of the engine shaft.

There may be, in the gearing itself, less friction than in the ordinary kind; but it is probably made about the same, if the whole machine be taken into consideration, for there is the extra friction on the pins of the universal joint, and the journal on the end of the pinion shaft. At high speeds there probably will be a vibratory motion resulting from the centrifugal force of the whirling mass; but, by a counter weight attached to the opposite side of the crank, it may be nearly if not entirely avoided.

An arrangement of this plan has been designed for horse powers; the pinion shaft standing vertically, and the fixed wheel lying in a horizontal position. It makes a very compact machine, with but few parts, and they not very liable to get out of repair, and is accessible on all sides.

Mr. Harrison exhibited a pair of light Russian overshoes or sandals. They have in the inside of the counter, a spring which secures the heel of the boot; this spring is released by pressing a small knob on the outside; they may thus be put on or off without touching them with the hand.

Mr. Harrison also exhibited a model of Wharton & Shiver's improvement in steam engines. The general feature of this machine consists in adopting the slot arrangement for changing the rectilinear motion of the piston to the rotative motion of the crank shaft, thereby dispensing with the connecting rod. This arrangement is already well known; the novel feature in the model exhibited is, in the peculiar shape of the slot, which, instead of being made with continuous straight and parallel sides, is made up of two slots parallel to each other, but not in the same line, connected together by a short angle, the centre of said angle being directly opposite the centre of the piston rod. In a revolution of the engine, the crank pin passing from half stroke towards the dead centre, moves in a direct line at right angles with the piston rod, until near the centre, when it enters the angle above alluded to, and quickly has its direction diverted obliquely, until it enters the straight slot on the other half of the stroke, at the end of which the movement is repeated for the remaining half revolution.

The value of the angle seems to consist in its causing the engine to commence its movement when directly in the dead point.

This invention is at present under consideration by the Committee on Science and the Arts.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on J. F. Mascher's Stereoscope.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "an Improvement in Stereoscopes," invented by Mr. J. F. Mascher, of Philadelphia, Pennsylvania—REPORT:

That the instrument submitted by Mr. Mascher, consists of a light lid or flap fitted into a case similar to those commonly used for daguerreotype pictures, and containing two lenses of short focus, and fitted to the view of any stereoscopic pictures fitted permanently or temporarily into the case. The advantages presented by this very neat apparatus of Mr. Mascher are; 1st, That from its simplicity it can be made much more cheaply than almost any other form of stereoscope; 2d, That when in action it allows the light to fall upon the pictures at any required angle, and in any desirable quantity, there being no solid sides to interfere with the arrangement of the light. In these two respects it shares its advantages with a light and cheap form of instrument which has been for several years in use. But, 3d, Mr. Mascher's instrument is very compact, the bent frame folding down into the case, thus allowing a stereoscope daguerreotype to be kept with its proper lenses in the same case that is used for ordinary pictures; and the mobility of the lens frame by its rocking motion on its hinge, gives very greatly increased facility for the arrangement of the focal distance to suit any eyes, and for the other adjustment of the lenses for distinct vision.

In reference to the originality of the invention, it is sufficient to say

that Mr. Mascher has obtained Letters Patent for his invention, and of course, the only proper course to attack him on this point would be by taking means to obtain the decision of a court of law upon the point.

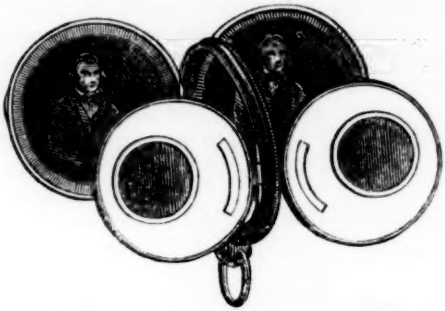
As this matter is not within the scope of the examinations of the Committee of Science and the Arts in such cases, they content themselves with recommending to general use, the stereoscope patented by Mr. Mascher, as being a very neat, cheap, durable, convenient, and easily adjusted instrument, superior, for ordinary purposes, to those forms commonly in use.

By order of the Committee,

WM. HAMILTON, *Actuary.*

Philadelphia, February 8th, 1855.

Since the adoption of the above report, Mr. Mascher has invented and submitted to the inspection of the members of the Institute, a stereoscope arranged in a locket of the usual form and size. The arrangement is illustrated by the accompanying wood-cut, and besides the convenience



of the size and mode of preserving the pictures, the lenses are made more powerful than those of other stereoscopes, and the pictures are thus more highly magnified. ED.

Report on J. W. Queen's Microscope for Students.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, a "Microscope for Students," invented by Mr. James W. Queen, of Philadelphia, Pennsylvania—REPORT:

That in the instrument submitted by Mr. Queen to the Committee, nothing of originality is claimed, either in the optical or mechanical arrangements, but the endeavor has been to produce an instrument containing, as far as possible, all the best qualifications, with such cheapness as will render it accessible to a much greater number of persons than are now able to procure them, and thus to spread the habit of using this very valuable instrument.

The instrument examined by the Committee, has its tube of brass furnished with the usual lenses, so mounted upon a cast iron stand as to be capable of motion in the vertical plane, so as to be used either vertically or inclined, and carrying a well arranged platform for holding the objects.